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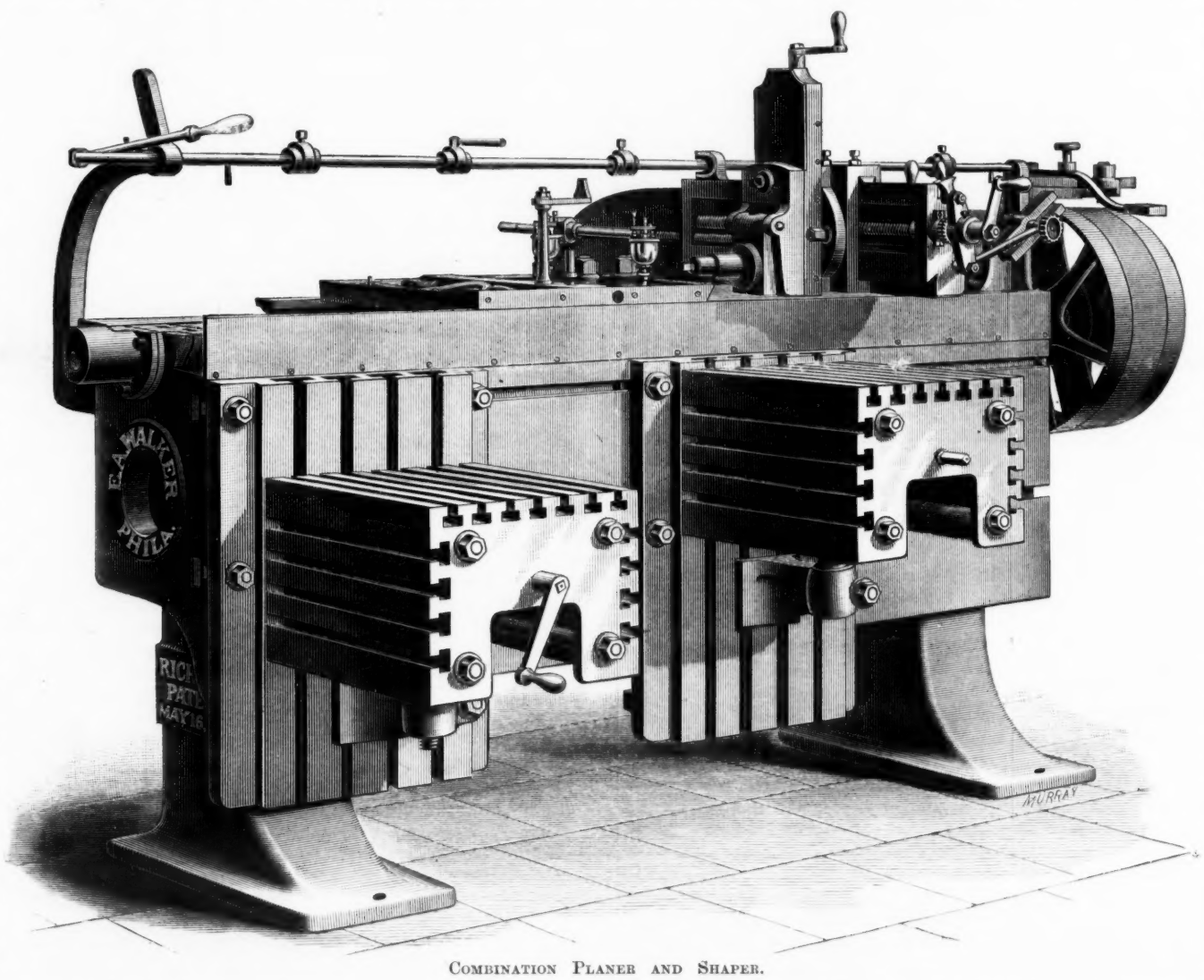
Richards' Combination Planer and Shaper.

We illustrated and described this machine in our issue of June 17, 1882; since then improvements have been made in its construction which are shown in the present engraving.

The bed, as here shown, is about 7′ long, and the machine will plane 50″ in length and from 22″ to 30″ in width, and 24″ in height when using the square tables. The height from floor to cutting point of tool is from 36″ to 48″, and if the machine is set beside or over a pit its capacity for difficult work is increased, and with the advantages of the open side, pieces of unusual dimensions may be planed with comparative ease. The cut shows the shortest bed that is made when supplied with more than one table, but they can be made as much longer as wanted, and provided with two or more separate tables, or one long table its entire length if desired.



COMBINATION PLANER AND SHAPER.

The overhanging arm is made to extend, for extra wide work, rather beyond the rated cutting capacity in width, and is quickly adjusted by means of the screw shown across the top of the carriage or saddle. The plates and square tables are moved into position on the bed by placing a pin in the saddle, and a short flat bar in one of the slots in the plates when, on starting up the machine the saddle will move the plate and table until stopped at the point desired. The lever with handle on the end of the shifting rod, and within reach of the operator, is used for the purpose of easily starting and stopping the saddle without shifting the driving belt to the loose pulley on countershaft. The shifting rod is also supplied with two sets of stops that may be used when planing work fastened independently to either of the tables, and the head and cutting tool allowed to move from one to the other by working the sliding stop-bar or lever, saving time that would be lost in moving and resetting with a single set of stops.

This sliding bar may be thrown out at any time, and the carriage or saddle run back or forward without disturbing the stops, leaving it in any position on the bed that may be desired. Safety pins are placed near each end of the rod to prevent the saddle from running too far in either direction, and no matter how forgetful the operator may be in this respect the saddle will reverse whenever it reaches the ends of the bed.

The feed movements are not fully shown in the cut, being on the back side of machine and in rear of the extension arm.

A friction arc sliding upon a bar, engages at the moment of reversal, and this movement is multiplied and transmitted to the cross-feed screw in the usual manner, as shown on outer end of arm.

The plate or guard running the entire length of bed, prevents chips and dust from falling or being brushed into the sliding parts, and has proved to be so effective in this direction that it will be in some form attached to all sizes of this machine. The fast or driving pulley, on the end of screw, has been usually constructed of iron, but after some experimenting with different pulleys it was found that one made almost entirely of wood gave the best results, reversing easily at a high velocity and consuming less power than the lightest iron pulley that could be made. The fly-wheel principle contained in an iron pulley of large diameter, running at a high rate of speed, is not wanted in this instance when shifting suddenly from one motion to the other.

The manufacturer is E. A. Walker, 75 Laurel street, Philadelphia.

A glance into a boiler and engine room sometimes serves to index the whole establishment.

The Pleasures of a Machinist.

BY PROF. JOHN E. SWEET.

When I made that rash promise to write something for the AMERICAN MACHINIST, I little dreamed of the amount of good paper that was to be squandered in the attempt and what a very long time "before long" was. This brings up the question: Did any one ever sit down to think of something to write and write anything worth reading?—present company (editor) excepted. Luck comes to the man who invariably pulls on his left boot first, and, being faithful to the superstition, it has come to me, as the following extracts from a private letter will show. F. P. Avery, of Tunkhannock, Pa., belongs to the craft, and among other things, he says:

"I wouldn't be anything but a machinist, with a comfortable income; and a country shop beats all places for variety. The queer jobs one gets to do keep him fully exercised. Last week I started a new engine for a saw mill eight miles away. The next day I went as far in another direction to patch a boiler and caulk the flues. The next day mended a pump barrel which came as near sticking your humble friend as anything I ever struck. There is almost always some way of griping a pipe or pump barrel to make a patched up job, until a new one can be got, but in this case there could be no gripe got on but a belted one. I shaped a patch of boiler iron to cover the crack, put thick pieces of leather under it in three places to hold it away from the barrel, then drilled through patch, barrel and all, and tapped through both and screwed screws in tight, cutting them off. This saved heads on the screws and made a smooth job. I then pulled out my leather strips, run lead in between the patch and barrel and caulked it tight. This made a splendid job. The idea was a new one, suggested by the job, and I am sure I shall have other places to use it if I live. Since I saw you we had a large engine come in to have the valve seat faced and a 'grate' (as we call it) put on. Our planer was not large enough to take it, and I leveled up a track under the upright drill and put the cylinder on rollers and cut down the valve seat with a square-ended cutter, using the face of the steam-chest as a gauge with a straight-edge and collar on the spindle to give the depth. I was thinking of your new mill planer while at the job, as well as how easily it could be done on a good radial drill. It seems to me all the comfort of the business is gone if one has every tool his mind could suggest, which is about the case in a well equipped shop. The comfort comes in when one turns out a good job without any help, only such as lies around loose and was never intended for the job in hand."

Nothing needs to be added to the above. The story is a sermon in itself. Many a country jour or machinist may say to himself, "No such jobs ever come to me." But if they do not I imagine it is not the fault of the job. Such are the men as would say to the owner of the pump, "it can't be fixed;" and the man with the engine cylinder, "you will have to take it to the city, our planer is not large enough."

From such a man as Avery there are many things to be learned. Among others, one that we frequently use, is the melting of yellow brass in a common iron ladle. Cover the top of the scrap brass with a piece of hemlock bark and the brass melts like lead.

"The fun of the thing" is what too many of our machinists fail to enjoy. Surmounting the difficulties; overcoming the perversity of material things; making the thing go when it will not go; doing something at which others have failed; devising dodges to meet the emergency; these gives one a sort of satisfaction, and are things in

which he is justified in taking a good deal of pride.

The real enjoyment comes more from the little things than from the more studied patentable inventions. In the latter case the trouble and annoyance of patent agents; rejections and amendments; the legal forms; the specifications saying what you don't mean and meaning what you don't say; having to pay and then trying to make something out of it—all wears out the fun and enjoyment long before the patent is granted or harvest time comes.

The real enjoyment growing out of the achievement of little things, during my varied experience, has made life rather a happy one, and whether fitting a board into an irregular space, where neither end could be tried until both ends were finished, or whether devising ways to do jobs in the machine shop, or circumventing mathematics on the drawing table, in no sphere have I failed to find these new things to do, out of which comes such satisfaction.

Baltimore Meeting of The Electric Light Association.

STENOGRAPHIC REPORT OF COMMITTEE ON BEST EQUIPMENT FOR ARC LIGHTING STATIONS, STEAM POWER, ETC.

[By courtesy of the *Electrical Review*.]

Frederick Fosdick, of Fitchburg, of the committee on "Best Equipment for Arc Lighting Stations, Steam Power, etc.," stated that the committee had not prepared a written report, and that he would make merely an oral report in order to bring the matter before the convention for discussion. The best steam power was in reality the question that was before the convention. Electricity is dependent upon steam power. Although there are occasionally arc stations run by water power, they are so few as to need no attention at our hands. The question of the best equipment is divided between the best engine and the best boiler. Mr. Fosdick here alluded to some early experiences with engines and dynamos, stating that high-speed engines were chiefly used in the initial steps of electric lighting, at that time close regulation being an essential. High speed and dynamos went together, and it has been pretty hard, until the present time, to dissociate those two facts. Of course, the electric light competes with gas. Just as soon as the question of the success of the electric light was settled, the question of economy came in. The question has come prominently to the front whether high-speed engines are the best, all things considered, economically and otherwise, or lower-speed engines, and to what degree low-speed is essential or advisable.

It is a fact that many of the largest stations in our country to-day are filled up with low-speed engines, higher, perhaps, than the old low-speed, but still, compared with the high-speed engines, low speed engines, and these stations are giving marked economy, and where there has been a comparison between these high and low speed, direct, practically, I think the decision has been that the light [from the low-speed] has been equal to that of others and the economy has been much greater. It is also true that the larger the engine, the closer the economy regardless of the high or low speed. The question comes in then, as to whether not alone in large stations using the large engines, low speed is economy, but whether, taking a given power, say 100 or 50 or 150 horse-power, without regard to the power of the engine, a low-speed engine of a given power is more economical than a high-speed engine of a given power. There are certain elements entering into high speed which are inseparable from it, which are elements of lack of economy. There are also elements of economy. The elements of lack of economy in a high speed are increased friction and increased clearance in proportion to the power of the engine. The elements in the low-speed engine are the necessity of a line-shaft to belt from, because it is almost impossible to belt from the pulley to the fly-wheel. The element of the large shafting is the principal element of loss in the low-speed engine. The question then is, whether the belting direct and the loss by clearance and these other items more than offset the question of the extra friction required by the line-shaft and the extra first expense on the lower speed. These questions, I think the majority of the committee who have this matter in charge will decide in favor of the low-speed engine, and I think I may say that for the majority of the committee, although I represent merely my own views. There are certain places where high-speed engines must come in of necessity. Lack of room in many cases prevents the application of the longer stroke and of the line shafting which is essential with the low-speed engine; so that in certain cases, regardless of economy, there must be the high-speed engine. With regard to boiler, the opinion of the committee, perhaps, would be that, all in all, the horizontal tubular steel boiler is the boiler for use in electric light stations. In my view the proportion should be, for 100 horse-power, 1 in 30 for grate-surface to heating-surface; such a proportion of tube-area to grate-surface as 1 to $7\frac{1}{2}$ or 8; a proportion of tube-length to tube-diameter of from 45 to 60. The diameter of tube would depend somewhat on the fuel used, larger for lighter fuels, smaller for more solid fuels—the harder coals. I think the space from the grate to the belly of the boiler should be not greater than 32 inches nor less than 24 inches. As to draft, my observation is that a large chimney and a very large draft-check is necessary. The setting of a boiler has much to do with its efficiency. I believe that a careful setting of the boiler to the very best plans that can be furnished, even at some additional expense, is a great saving over the usual setting of boilers."

A. F. Upton, Boston—"At least half the arc light stations, and at least three-fourths of the incandescent light stations in the United States use high-speed engines. We have between 40 and 50 stations now, and I am happy to say that all our stations are on a dividend-earning and paying basis. I think that fact settles a good many difficult points."

Mr. DeCamp, Philadelphia—"I would like to have the question of clutches discussed here. I think everybody is interested in it. I think, as the business grows, we will all be running under similar conditions. We have one plant, or rather two plants in one. We have got 250 or 260 day-lights. Of course, we would rather have it at some other time. We have only four hours of economical load on our engines, and I do not see any way of getting around it. If we could have an engine of half the size to run on this day load, and use our large engine, say from 4 to 12 o'clock at night, and then cut off on to a smaller engine working up to its economical point, we would be getting at the highest economy in the motive power. As yet, we have learned of no clutch which we have any reason to believe can be depended on."

Mr. Evans, Baltimore—"When we first started, we tried a small engine that we replaced with a larger one. I have demonstrated by experiment, both here and in Norfolk, Va., that there is more economy in running a long-stroke engine. The Armington & Sims, and several other engines, which have been tested at Norfolk, have been giving good results. But I think if the Norfolk people had to rebuild their stations, they would certainly put a long-stroke engine in. Their consumption of fuel down there ranges from 56 to 62 pounds per lamp; whereas here in Baltimore we use an average of about 36 for the same number of hours run. Our experience with clutches was so unsatisfactory that we took them all out. They were a complete failure. We have adopted the fast and loose pulleys, and they have given us the best results. I do not know of any clutch in the market that is capable of doing the electric-light work, though I admit a suitable clutch is probably the thing we want. We are using the Jarvis furnace, and it is giving us everything we expected from it. The retort furnace was a complete failure with us."

Mr. McGrath, of the New York Brush Company—"We have now in our stations in New York, about 1,000 horse-power. It is nearly all made up of what we term slow-speed dynamos. Each of those engines is coupled up with what we term an internal gearing, so that we get the advantages of a high-speed engine, without the disadvantages. We found it was economical not to use any clutch pulleys, loose pulleys or anything else. Each dynamo was belted direct to its own line of shafting, and we calculate to keep on each engine one spare machine. We have also two small Ball high-speed engines that make a great number of revolutions a minute. The piston speed of those engines is not so great as the piston speed of our large engines, but they turn around more times in a minute. We are satisfied, from our experience, to use the low-speed engines. We use the plain tubular boilers. Our boilers are 17 feet long by $5\frac{1}{2}$ feet in diameter. We have fifteen of these in use. We use the Jarvis furnace. Most of our machinery has been running now for a little over four years, and we have never been obliged to stop one of our engines for any purpose whatever from the time we start till the time we shut down. We have never had occasion to reset one of our boilers. An electric-light station, properly equipped, will be so arranged by switching arrangements that we can stop any engine, any machine, in any part of the station and change it on to another machine in another part of the station without any loss of time. We find no difficulty in doing that at all. We use bituminous coal. We burn this time of year twenty tons a day. We figure our consumption of coal and everything in dollars' worth. As to the amount of coal we burn per lamp, it costs us $2\frac{9}{10}$ of a cent for each lamp for ten hours—that is, a 2,000 candle-power lamp. My experience with fast and loose pulleys on dynamos has been that it takes as much power to run them as the dynamo."

J. F. Morrison, Baltimore—"The New York station, when first equipped, had the same sort of switching arrangement as the old Twenty-fifth street station in that city had. I have not seen it since then, and I did not know but the gentlemen in New York had invented a plan by which they can handle this thing better than is done in other parts of the country. But I find that from the coupling up of their machines that if a machine is disabled he has got to keep on running all night long. Now, a condition may arise whereby a machine, being disabled, will so cross-connect itself that, unless you stop the machine, it is going to set things in a blaze; so that there is a clear case where the entire plant on that engine would have to stop, in order to get rid of that machine. To return to the switch-board again, it is quite common for the Baltimore men to make the changes suggested by Mr. McGrath. We have just a barely perceptible darkening of the lights. Our switch-board is arranged with swinging jaws, and into the jaw is introduced a plug switch with a wooden handle. The handle is hollow, and the wires are carried up through the handle to the solid part of the plug. The switching is done by operating quickly, and introducing the plugs again. As to estimating the cost of fuel in dollars, that is the method which seems to be adopted by the gentlemen with whom we have been in correspondence, who do not want to tell anything. In our station, we use a mixture of slack, soft coal and anthracite, mixed with three tons of screenings to one ton of soft coal. Of that mixture we use four pounds and a fraction per lamp per hour, varying to some extent upon certain varying conditions with which you are all familiar. The price of our coal varies. In January, 1885, we paid $1.90 a ton for the mixture; in January, 1886, they stood at $2.10 a ton. Owing to this heavy storm, we were unable to get the screenings into the station, so that gives you the reason for the increase of price there. We ran out of screenings two nights last week, and we then ran our engines on bituminous coal entirely. The cost of that coal was about $3 a ton and a little over. We found that, instead of 4 pounds and a fraction, we were using $3\frac{1}{2}$ pounds per lamp. The difference in the cost was very much in favor of the mixture. We use the Jarvis furnace, which I consider that all well-regulated electric-light stations ought to use who are trying to bring about an economy of fuel. We use a Ball engine connected to one of the twenty-six Brush machines, sixty-five lights, and in that case we have an illustration of the direct belting with extreme high speed. In the other cases we use the Buckeye engine, 15x30 and 16x32. If we were to increase our plant now, we would put in a 600 horse-power engine instead of six 100 horse-power engines. As to carbons, we use more largely of the Brush carbons than any others, but we will use more largely of the others unless the Brush Company reduces the price very materially. It is important to have a skillful efficient and zealous superintendent. If you have a slouchy, easy-going superintendent, you will spend more money in that department, without getting proper returns, than in another department."

Mr. Smith, Jamestown, N. Y.—"The only engine that finds favor in England now, is the compound condensing engine. My engine at Jamestown, is a compound condensing engine. We run at 72 revolutions a minute. As a proof that we get the steadiest light possible, we are running the incandescent light on the same circuit with the arc light, and there is not the slightest perceptible flicker. You cannot get economy with a single-cylinder engine. You cannot get economy with a high-pressure engine."

Mr. Cooper, of Brooklyn—"Our objection to using condensing engines in our cities is the cost of water. It would cost us more for the water than for fuel."

Mr. Smith—"I recognize that in many cases it cannot be used. But where you can get water for nothing, it will be economy to use it. The maker of the engine I have, will put in an engine and guarantee that it will not cost more than £1 a year for fuel, and your coal bill shall not exceed £300 a year for 300 horse-power."

Mr. Kerr, of New York—"We know that compounding produces a very great effect upon the differences in cylinder temperature and that is one of the objects of compounding, even if we leave out the question of condensing for vacuum."

Mr. Upton—"We have an Armington-Sims engine $16\frac{1}{2}\times24$, which is doing a duty of $2\frac{3.8}{1.6.0}$ pounds of anthracite coal per horse-power."

Mr. E. T. Lynch, New York—"We have just put in a 500 horse-power condensing engine, known as the Watts-Campbell-Corliss engine. We get our water from Twenty-ninth street at the East river. The consumption of fuel in that engine is $1\frac{7}{8}$ pounds of pea coal per horse-power per hour."

Mr. Weeks expressed himself in favor of the large engine. "As regards economy," he continued, "I think there is no question but that the balance is in favor of the large engine, We have demonstrated that matter in our plant. We put in a 150 horse-power Corliss engine, and we found we got better results out of those large engines than we do out of smaller engines, which we have subsequently put in."

Mr. Kerr said that a large engine of any kind is more economical than a small engine of the same kind. A large engine of almost any kind is more economical than a small engine of almost any kind. A large single-valve engine is more economical than a small four-valve engine, etc. Until you get to about 75 horse-power, it does not make any difference what kind of engine you use for economy.

Professor Sweet—"I would like to help the gentlemen out. If they have engines that are governed as closely as I see some engines governed, there would be no difficulty in using the ordinary clutch. If your engines do not govern close enough, why not put counters or indicators on the two engines, start up your engine, running on till it comes up to the speed of the other engine, then pull on the other clutch, the minute the introduced engine takes the load and the other is shut off, one will take the load. Pull out your clutch and let it go on. It seems to me there is no trouble at all if you come back to the original clutch."

Mr. Gardiner Sims—"In regard to the high-speed engine, we placed three in the Edison Central Station, in Pearl street, New York. They were $14\frac{1}{2}$ in. diameter by 13-inch stroke, and two ran 350 revolutions.

One of them ran sixteen days for seventeen and a-half consecutive hours, making 8,500,000 revolutions without stopping. These engines have been in use three years and three months, at eleven hours a day, and they have made 272,000,000 revolutions. The expenses for the three engines for the three years and three months have been $41."

Mr. Kerr—"We recently made a test on a 12 x 11 engine running, I think, 320 revolutions, which was put in under a guarantee of $3\frac{75}{100}$ pounds of coal and the test was made and showed an economy of $3\frac{23}{100}$."

The discussion, after same further remarks by Mr. Fosdick, Mr. Smith and others, was closed.

The next meeting of the association will be held in Detroit, Mich., in August.

The Belknap Straight-way Check Valve.

We present with this, engravings representing different forms of these valves. The check is swinging, and works equally well vertically or horizontally. Figs. 1, 2 and 3 represent the valve made in the form of a union. When used with large-size pipe no other union is required. The valve and seat are entirely distinct from the shell; they can be removed when the shells are screwed on the pipes, thus avoiding injury to working parts. When in place, if inspection, repairs or renewal is necessary, by taking out two of the bolts the working parts can be removed without disturbance to pipe or joints.

Figs. 4 and 5 represent the valve as adapted for use with injectors, oil pumps, etc. Figs. 6 and 7 show it as designed for use on radiators, portable and locomotive engines. In radiators of the two-pipe system, trouble sometimes arises by closing the feed valve and neglecting to close the drop valve. Placing the check on the drop or outlet, corrects this. The check remains closed except when opened by the condensation of steam; when the water is out it immediately closes. Being a union valve it is easily disconnected when it is desirable to remove the radiator. In these valves it is claimed that the large area of the cup-shaped seat permits the valve to work to the capacity of the pipe with small lift, thus adapting it to work especially satisfactorily with quick-running pumps.

The manufacturers are the Belknap Manufacturing Company, Bridgeport, Conn.

Improvements in Casting Steel.

The invention of Mr. Thomas Gilmour, of Kilcattan Tile Works, in the County of Bute, North Britain, has for its object, to obtain sounder ingots or other castings of steel by diminishing or preventing the formation of cavities or honeycombing in the metal; and the invention consists in subjecting the mould with the steel in it to concussive action whilst the steel is in a melted state and setting. The concussive action has the effect of promoting the ejection of any gas contained in cavities in the metal, and at the same time of consolidating the metal, by forcing the particles into close contact. The apparatus is made to repeatedly lift each mould and drop it through a short distance, thus imparting the desired concussive action. A massive fixed platform is provided, and is formed with guide sockets for pedestals, formed each on the underside of a table, on which a mould is placed. Below the platform there is carried in suitable bearings a horizontal rotating shaft, driven by any suitable prime mover, and having on it cams, placed so as to act on the lower ends of the pedestals. As the shaft rotates its cams lift up the tables and moulds and let them drops a short distance. According to another modification, arrangements may be made for suspending each mould, or a set of moulds, or its support, from overhead mechanism, which will repeatedly hoist it up and allow it to drop through a short distance. In carrying out this invention it will be desirable to have the mould of sufficient strength by being bound with iron hoops, or encased in an outer iron shell, to resist the increased internal pressure which will be caused by the concussive action. Mr. Gilmour claims as his patent: subjecting a mould, in which steel is being cast, to concussive action whilst the steel is in a melted state and setting, substantially as described.—*Engineer and Iron Trades Review.*

Rotative Speed of Self-contained Engines.

BY W. H. HOFFMAN.

In the AMERICAN MACHINIST of Feb. 27th, I stated that the shaft end of the moderately or excessively high-speed engine required more attention in construction than the cylinder end. I think I specified the valve-motion as requiring little care when properly made, and, in speaking of valve motions, I include *all* the standard devices now in general use. As to the piston, its rod, and the crosshead, I will leave these important details of transmission to be noticed hereafter, and confine my remarks in this article to the main shaft bearing, the crank-pin and connecting-rod.

The writer knows of over twenty different designs for main engine bearings that have actually been in use, and three-fourths of these have been abandoned for the reason that they were troublesome. Most of these bearings were in four pieces, two of them being side boxes adjusted to the shaft by wedges or set-screws. Of course large and long bearings under high speeds, are the most unreliable, I mean shafts from $5\frac{1}{2}''$ to $13''$ diameter with bearings from $10''$ to $23''$ in length.

Such shafts in *moderately* high speeded engines, would run 200, and 90 revolutions respectively. I have seen very many of the four-part bearings that have evidently been well fitted in the shop, and carefully adjusted by compentent erecting men, give constant trouble for months after first starting, even when copiously supplied with *special* lubricants. The trouble was not from bad workmanship, but from imperfect design or proportions.

When a box is made in four sections, divided on its diameter, the lower portion requires only surface area enough to carry the weight of the shaft and the parts carried thereon.

The top portion, as a rule, requires less than the lower one, so that the two side pieces may have the larger part of the surface for the real load or longitudinal thrust. All builders of steam-engines have probably noticed that the engine of to-day is more troublesome at the journals than the engine of twenty-five years ago; then the boiler pressure ranged from 45 to 65 pounds; now it runs from 75 to 100 pounds per square inch. Thus the initial blow at each center has been increased about fifty per cent., but some builders have not provided for this increased labor on the main journal and pins.

There may have been additions to the surface of the main shaft bearing, but they have not made due allowance in *strength* for the extra force or thrust received from the initial steam pressure, so that the side pieces will not spring. Some of the side boxes are so light that by the repeated blows from the initial steam they are hammered and permanently stretched out of true form, thus losing in some cases, more than *one-half* of their proper bearing. Under the above conditions the oil is driven from the journal, and this hastens the final result, viz., the necessary refitting of the boxes.

Long side boxes should be *divided* in their length *once* at the center, each piece having its own wedges or screws for adjustment. The lower portion of the box should be tapped for an eye bolt, and so fitted that by raising the shaft $\frac{1}{16}$ of an inch, this section can be drawn out and scraped or refitted if necessary. Of course space must be left on the shaft to allow for moving the eccentrics, etc., back to clear the box when being removed.

When first experimenting in high rotative engine speeds, I approached 250 revolutions with a $5\frac{1}{2}''$ shaft with considerable caution. I had previously run a jack or countershaft with a diameter of $5\frac{1}{4}''$, 280 revolutions per minute, transmitting 380 horse-power. On this shaft were three heavy pulleys, two belts pulling horizontally, and one from below at an angle of 40°. There were four bearings on this shaft at $4\frac{1}{2}$ feet centers, each bearing $14\frac{1}{2}''$ long, and none of them ever heated. The shaft was ground on its centers for th bearings, and the babbitt-metal in the boxese was channeled in spiral grooves $3''$ long and at intervals of $1\frac{1}{2}''$ all lapping each other.

On speeding up the engine shaft, I was aware that the conditions were different, as in one case the strain was nearly in one direction, and without opposite side blows or thrusts, while in the other we had these blows due from the entering steam and a variable pressure, and having the direction of pressure changed at each revolution. I found, therefore, that the "pounding" action of the steam was severe on the side boxes even allowing for the gradual seating by compression, but when the boxes were made in a substantial way there was no trouble in getting the 250 revolutions, and keeping that speed steadily.

Of equal importance is the *main crank-pin*. After making pins of various lengths proportioned to their diameters, I have concluded that $1\frac{22}{100}$ times the diameter is the best length, the diameter in all cases assumed to be $\frac{27}{100}$ that of the steam cylinder, and supposing the steam-chest pressure to be from 75 to 100 pounds per square inch.

The pin *must* be ground in the lathe on its centers, and the hole in the crank bored, as described in my remarks on self-contained engines. The pin should be steel, and the boxes must be lined with babbitt-metal of the best quality, and I should have said that the main shaft should also be steel for any speeds above 125 revolutions, and the bearings lined with babbitt-metal.

The crank end of the connecting-rod should be forged solid, the most reliable style for *any* speed. One half of the box can then be fitted securely into the end of the rod, and the adjustable half against a steel wedge, that should cover the whole length of the box. The wedge should be moved by two fine-threaded steel screws, entering the same hole from the opposite side of the rod head.

The sectional area of the combined sides of the rod at the mortise, should be $1\frac{1}{4}$ times the largest area of the piston-rod, after deducting the holes for wedge screws, and this proportion will leave the rod-head light and strong; two indispensable points in high speeds.

Regarding hot crank-pins, I will say that there is little excuse for this trouble, if the proportions are correct, and the work is well done. Most of the mischief is caused by *gripping* the pin with the boxes.

Keys with a small taper, invariably cut the pin, even in the hands of experienced men. With the key, it is the common practice to drive to marks, and as the boxes wear, to make new marks, and so on. The wear of a well-proportioned steel pin amounts to little, and, this being the case, I have generally made the pin with a false outside collar, held to the pin with a stud screw. The pin is made an eighth of an inch shorter than the box, and I then make a steel diameter gauge enlarged above the diameter of the pin, enough to allow the oil to freely traverse the pin's surface, and as the boxes wear I set them by the wedge screw to this gauge, and this will prevent the gripping of the pin. The gauge can always be ground to size.

Thirty years ago I knew an engineer and master mechanic who, after erecting an engine, would wipe the boxes and pins clean and dry, then softly drive the keys until the rod would slightly rattle on the pins, but when the oil was poured into these boxes, the rod could not be rattled with a ten-foot crow-bar, and these pins never caused any trouble from heating, and the keys were rarely moved under a week after they were driven *before* starting the engine with its regular load.

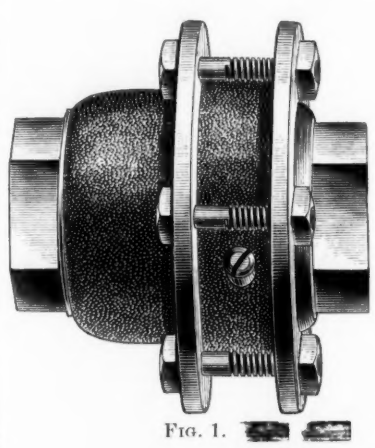


FIG. 1.

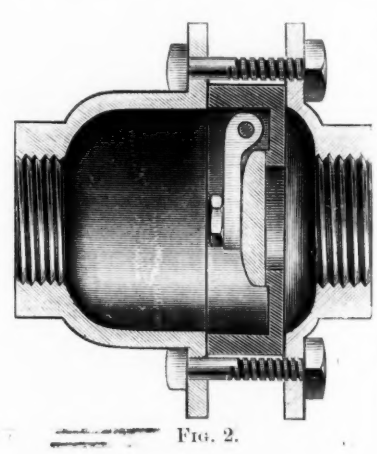


FIG. 2.

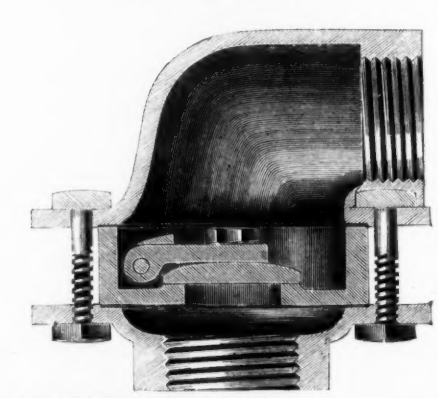


FIG. 3.

FIG. 4.

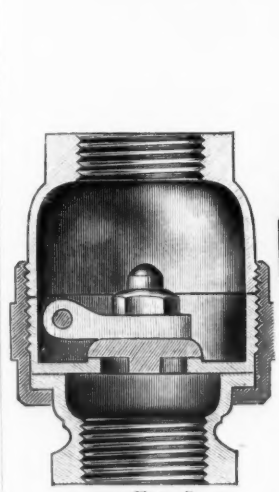


FIG. 5.

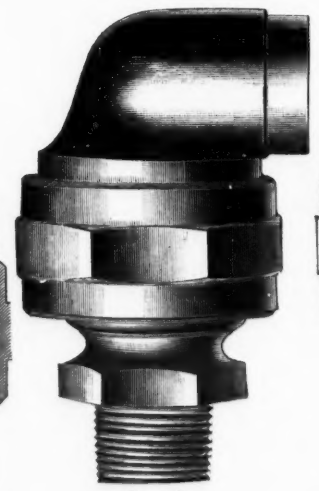


FIG. 6.

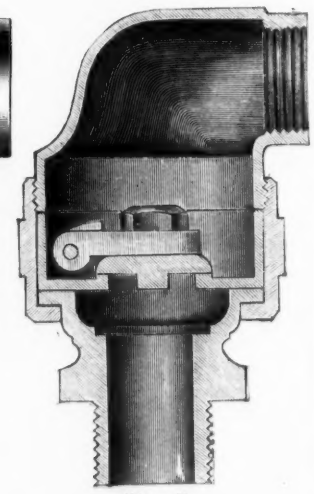


FIG. 7.

THE BELKNAP STAIGHT-WAY CHECK VALVE.

Engineers' Club of Philadelphia.

At a late meeting of this club, Howard Constable gave an interesting account of the system used in London for the Public Supply of Hydraulic Power, which he has recently had occasion to examine. The company in London was started in 1882, based upon the success achieved by a similar scheme in Hull, which has been in operation some eight years; it in turn was the outgrowth of a system which prevails very extensively in many English manufacturing and warehouse concerns, — that of employing hydraulic cranes, hoist-capstans and the like, and operating them from one pumping station. This plan was advocated by Mr. Bramah as early as 1802, and during the past forty years Sir William Armstrong has done much toward putting it into practice by the manufacture of hydraulic plant, so that the advantages of the principle are much more thoroughly understood abroad than with us. The general mind in this country looks with some fear upon high pressures and thinks the system rather novel, not knowing that in our practice in the pumping of oil to the seaboard, pressing cotton and extracting oil from seeds, we employ hydraulic pressures ranging all the way from 400 to 5,000 pounds, and over, per square inch, whereas the London Supply Company use only 700 to 800 pounds.

Their plant consists of about twelve miles of cast-iron mains distributed throughout the busiest parts of London, on both sides of the river, and as far west as Victoria Station. The mains and branches are laid so as to avoid any dead-ends, and with stop valves so that any length of 1,000 feet can be isolated. The water used is taken from the Thames and filtered into tanks, from which it is received by the pumps and passed into two accumulators, thence on through the mains. The pumps are of the vertical three-cylinder, fly-wheel type, compound-condensing, single-acting plungers, directly connected to piston-rod. The starting and stopping of the pumps is done automatically by the accumulators; and in connection with this, the arrangement for letting live steam into the low-pressure cylinder is very ingenious. The boilers are of the Lancashire type, fitted out with automatic fuel hoppers, stokers, etc., and fuel elevators. The charges for power water are made upon meter register and a sliding scale of prices. The financial success of the company was almost assured from the first.

Gmelin's Cupola.

The cupola in general use, says the *Mechanical World*, consists of an iron shell with a lining of firebrick and ganister, which is subject to deformation by fusing and combining with the impurities in the iron, and consequently requires continual repairs and frequent renewals, besides causing an irregular descent of the iron and a bad distribution of the blast when the lining becomes deformed. Dr. O. Gmelin has substituted for the fireproof lining a jacket, in which water circulates. This cupola has been in use in Austro-Hungary since 1881, and is now being introduced into Germany.

The cupola consists of two concentric cylinders of boiler plate, with a space of 4″ to 5″ between them. At the bottom they are connected by a riveted channel iron ring, and at the top, are covered with a similar ring with annular grooves, into which the edges of the two shells enter, so as to be secured in position. The top ring lies loose, on the shell, so that if steam should be formed in the jacket it can lift the ring and escape before attaining a pressure which could injure the shells. The rivet-heads inside the internal shell are hammered flat, the inside roughened, and covered with a fireproof coating only 1½″ to 2″ thick. The bottom end of the jacket rests upon a low iron continuation lined with fireclay, in which the iron is collected, and which contains the tapping hole, but the scumming hole, as well as the tuyeres, pass through the water space. Dr. Gmelin uses two tuyeres, which deviate about 10 degrees from a diametrical position. The cooling water circulates through the jacket, entering at the bottom and flowing out at the top, the overflow pipe discharging the water into an open funnel, so that the temperature can be easily observed.

A cupola constructed in this way has been in use since May, 1881, at the wagon works of Messrs. Ganz & Co., of Buda-Pest. The height from the drop bottom to the charging hole is 13′, and the inside shell 34″ in diameter, which, after deducting the lining, makes the internal diameter of the cupola about 31″. The two tuyeres placed as mentioned above are each 8″ in diameter. With a blast pressure of 14″ to 16″ water, 5 tons of iron are melted per hour, with a coke consumption of 5 cwt. to 6 cwt., exclusive of the coke for lighting. The water for cooling the shell averages 135 liters per minute, and leaves the jacket at an increase of temperature of 40° C., so that 5,400 calories are abstracted per minute. Although this can easily be ascertained, it is impossible to make any calculations to show how this loss compares with those occurring in an ordinary cupola. Possibly the formation of carbon monoxide is reduced or stopped by the lower temperature of the water-jacketed cupola, which would be in favor of the latter. The firebrick lining of the ordinary cupola also transmits heat to the outside, and has at the end of the blowing a considerable quantity of heat stored in it, which is completely lost. As these losses have never been accurately determined, a numerical comparison with that occurring in the jacketed cupola is impossible. But assuming the statement about the coke consumption to be correct, it must be admitted that the new cupola does not use more fuel than the older ones, and even belongs to the most economical kinds, while the absence of repairs and renewals would be a decided advantage. These not only cost annually a certain sum of money, but also compel every foundry that is at all busy to keep a cupola in reserve, whereby a further sum for interest and depreciation is absorbed.

Inventory Valuation of Patterns.

The Philadelphia firm whose inquiry led to the articles, on the above-named subject, published in our January 9, February 13 and 20, 1886, issues, write us in acknowledgment as follows:

We find that the views expressed compare very nearly with the opinions we held regarding the proper value to be placed upon patterns, and when we revised our list the first of this year we adopted the plan spoken of by Messrs. Sellers & Co., although we have not followed the matter in such detail as they illustrate.

We have a number of patterns that were made for repair jobs where we made the party ordering, pay for the cost of the patterns, and we still preserve the patterns thinking that at some future time we may have a similar case, but we do not place any value at all on such patterns in taking them in our inventory.

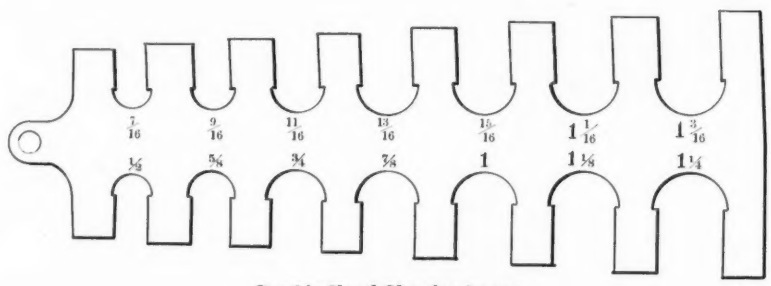
From the treatment of the subject in your paper it seems we are on the right track, but it is a consolation to have our views confirmed by such worthy authorities.

"Drawing Air," Gate-stopper and Chaplet-gauge.

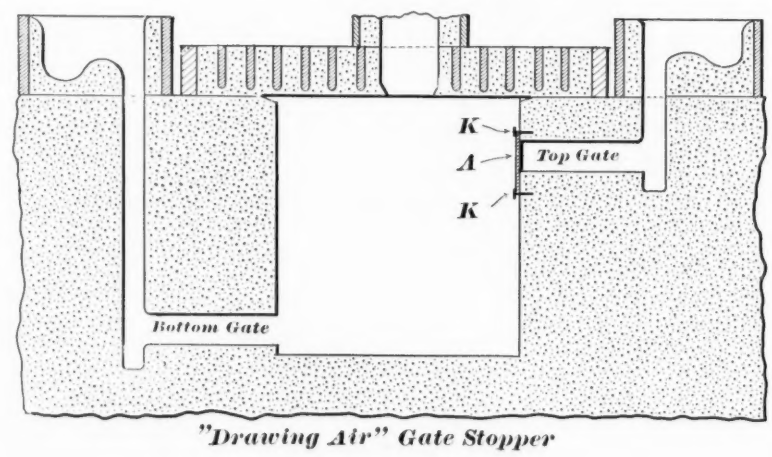
By Thomas D. West.

In pouring heavy castings it is essential that all risers, gates, etc., other than through which the metal flows, should be air-tight. Having openings through which air can escape, when a heavy green-sand casting is being poured, will, as a general thing, cause scabs or "mould blowing."

With heavy green-sand castings, where two ladles are used, having one gate above another, similar to that seen in accompanying engraving, the custom heretofore generally followed has been, in order to prevent the upper gates from "drawing air," to keep them closed by means of "gate-sticks," and when it was thought time to commence top-pouring, they would be pulled out. This, where it is not practicable to admit of the metal being above the gate entrance before "pulling the gates," always causes more or less "drawing air," and therefore risk of injury to a casting.



Double Head Chaplet Gauge



"Drawing Air" Gate Stopper

A very simple wrinkle to overcome this risk, and one which may be often practically applied, is illustrated at *A*. It is simply nailing a thin sheet of "tin-plate" over the gate entrance, which is readily opened by the force of the gate's head, when the top pouring is commenced. The nails, *K*, used to hold the tin-plate *A*, of course, required to be very light and placed straight.

For castings where tin-plate might remain unmelted, and float to parts requiring to be bored or finished, also where any danger might be apprehended of the tin-plate stopping the entrance of the metal to the mould, plates of sheet-zinc might often be advantageously used, because of its melting point being much lower than that of tin-plate. For castings where the upper or cope surfaces require a perfect finish, either might be objectionable; this would, of course, be decided by the casting's shape, and how and where it would be "gated." The credit for the above tin-plate wrinkle is to be given to Robert Watson, of Cleveland, Ohio.

The chaplet-gauge shown is a sketch of one similar to that which the writer has used for some time back, for calipering double head chaplets. Its advantages over methods generally used for measuring chaplets, will be seen at a glance. The principal one is that it does not limit the construction of a gauge to any special form. The idea is simply to have, by the use of sheet steel cut out to the fractional parts of an inch or inches desired, a rigid gauge, whereby double-head chaplets can be reliably and quickly measured.

In regard to the accident at the Mecklenburg (N. C.) Iron Works, E. W. Thompson, writes us:

"Three men were on an elevator with three reaping machines, going up to the top story of building. The hickory tongues of the machines were standing on end, and, just before the floor was reached, the long tongues struck an overhead beam. The ¾″ cable snapped instantly, and the elevator fell about twenty-five feet to the bottom of shaft. Two men were almost instantly killed, and the third was dangerously injured."

LETTERS FROM PRACTICAL MEN.

A Correction—Different Methods of Learning a Trade.

Editor American Machinist:

"Working Steel and Iron," in your issue of February 13, contains some awkward expressions for which I suppose I am to blame, although I cannot conceive why I should have written what strikes me, on seeing it in print, as so faulty. Will you kindly permit me to reconstruct some sentences?

"That he had discovered that the molecules in iron and steel had their axes longer in one direction than in the other, and that they arranged themselves with their longest axes in the direction in which the working had taken place," should read . . . "had their diameter longer" . . . and again . . . "with their longest diameter" . . substituting the word diameter for axes in each case. While in the sentence below, "The axes would be parallel with the axis of the bar," the same substitution of the word diameter for axes should be made thus: "The longest diameter would be parallel with the axis of the bar."

The idea which the distinguished expert in metallurgy had conveyed to my mind was, that the molecules were of spheroidal form, with a longer diameter at the equator and a shorter diameter at the rotating axis, and that the direction in which the working took place determined the arrangement of the molecules, which would be, with their equators—longer diameters—in parallel lines to the length of the bar, in the case of longitudinal working, as in the rolling of bars in grooved rolls, while in the case of rotary rolling the axes of the molecules would be arranged parallel to the length of the bar, and with their equators—longer diameters—across the bar, thus accounting for the otherwise—to him—strange fact that in some of his experiments with rotary rolling, bars had actually increased in diameter.

I have recently had some very interesting correspondence with a mechanic who is located in what was known a few years ago as one of the border states of the west. His case is this: As a boy, with the mechanic instinct strong within him, he desired to learn a trade. His father, a farmer, wished him to continue farming; this he did until reaching majority. He bought a few tools, and with no instructor commenced a blacksmithing and general repair business, which he continued for two years, when, selling out, he went still further west, and entered into partnership with a blacksmith from New York. After one month their shop was burned, with all their tools, and he concluded to return to his own home. Returning to his native state, he built a shop, and continues in the same line—blacksmithing and general repairs. His machinery is run by an engine which he built himself, except the cylinder. He has a screw-cutting lathe and other tools, casts and fits up brass boxes, and does general repairs, letting no job go away that can be done outside of a regular machine shop. He is now thirty years of age, with wife and children, and is not content; wants to know more about machine-shop and foundry work, but don't know as it would be prudent, under the circumstances, to enter a shop as an apprentice. Friends advise him to do so.

I replied to him, in substance, that, however much might be said in favor of the apprentice system in a general way, with the thorough mechanical education in a practical

sense which it made possible, it did not follow as a natural consequence that all who served a regular apprenticeship must become good workmen; in fact, that it was often the case that jours with many years of practice as such, after having served their time as apprentices, were still incapable of doing first-class work, while there were many cases in which boys, or men with very little practice, learned to do good work, and with continued practice became as good workmen as those who had learned their trade in the regular way; that in his case, with the peculiar capacity for learning which his letters show that he possesses, taking into account his age, and the facilities which his own business will furnish for learning much which he is so anxious to know, I would advise him to stick to the business he is in, and, if by increasing it sufficiently to employ help, he will make it a point to hire first-class workmen in his line, he can learn from them in his own shop as well as from the same men in somebody else's shop.

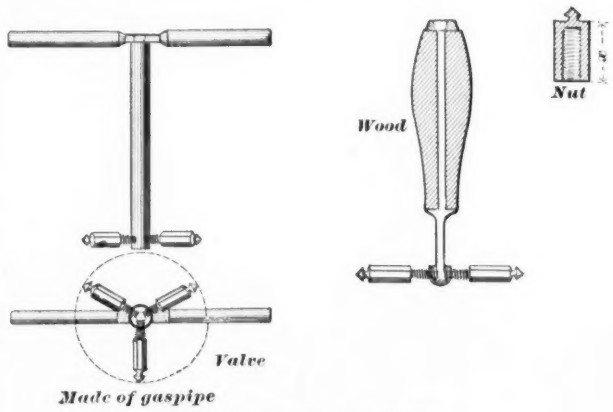
My correspondent goes on further to say that "many men ignore the natural knack and ingenuity enabling some men to become good workmen with little instruction, and seem to think that all who work at a trade of their own pick up, ought to be kicked out of it."

The further reply which I made to this was that if he really had the ability, or if by perseverance he acquired the ability, a straightforward, industrious course, with such habits as would insure him the reputation of being a man of good character, would soon silence all questions as to how he learned to *do* what his patrons *wanted* done. Is there not a great deal in this question of what is best for a boy or young man to do regarding the rigid discipline of years in the learning of a trade? If the ultimate and uniform result of serving a term of years as apprentice, was good workmen, while all who pick up trades were botches, it would be easily settled. If it were not a fact that to learn in some shops all which it was considered necessary for an apprentice to know, to be a first-class workman in a particular shop, or in other shops of the same standard of excellence or inefficiency, had often been the basis for rejection on the ground of improper practices in other shops, where a thoroughly green hand, with nothing to unlearn, would have been considered better, the question would be narrowed down immensely. It would be, of course, reprehensible for a journal like the American Machinist to teach, or to permit its contributors to teach through its columns, any doctrine which tends to lower the standard of workmanship among mechanics, or which dampens the ardor and narrows the ambition of the young; but is it not safe, does not common sense and justice demand that ability possessed by a mechanic should be recognized regardless of how it has been acquired? The skill and effectiveness with which a mechanic, one thing at a time, *does* that which his chosen or accidental avocation fills in his time with doing, constitute the basis by which his value to his employers or patrons is estimated, not where or how he learned, but does he know? Can he execute? In medicine and surgery, where the preservation of life depends upon a knowledge which it is conceded by all must be acquired by painstaking study, it is right that only those who can show satisfactory evidence of having at least taken the steps to acquire the necessary knowledge shall practice. So in some positions, which may be classed as mechanical, like that of the stationary or locomotive engineer, on whose knowledge and thorough acquirements depend the life and safety of others, there should be, perhaps, the ability to show that such places of responsibility are filled by those who have had the opportunity at least to know all which it is so important they should know, but when a man is hired to run a planer, engine lathe, or milling machine, if he does the work entrusted to him well, and in sufficient quantity; who thinks of putting him through an examination to learn if the methods by which he acquired the knowledge were regular, or whether he had picked up what he knows? Is it not fair to admit, ought not mechanics to claim as something to be proud of, that there is as truly genius in a mechanical direction as in any other? We select from certain families, of some particular breeding, untried colts, for which to pay prices two or three thousand per cent. above that which would buy common stock, because it is morally certain that a season's handling will develop a two-thirty gait in the one, with ground for hope that even Maud S may in time be beaten, while in the case of the other the certainty is just as great that handling for a lifetime can never drive the cold-blooded equine a three minute gait. Should we not then be ready to recognize the difference in boys and young men, which grows out of breeding and training, and opportunities, or their lack, through succeeding generations, as truly as among horses?

To those who have had the management of help, largely made up of boys or quite young men, the wonderful capacity which some have for doing difficult work right from the very first, as it were intuitively grasping the situation at a glance or learning the whole business with the slightest opportunities for observation in cases where the average help only learn to do the same indifferently, with months or years of training, and the dullards cannot learn at all, seems little short of miraculous. Should not these representatives of innate genius among mechanics have full credit for what they do, and not be taunted because a full apprenticeship term was not required to learn?

If it be so that we disagree on this point, we can surely come together on this ground. The reading of mechanical books and journals is one of the strongest factors in the direction of improvement to the mechanic, be he the apprentice learning, the jour, still learning, or boss, foreman, superintendent, or proprietor. The man of thirty who takes four mechanical papers, as my correspondent previously referred to does, and has still contemplated seriously the giving up of an established business to become an apprentice, because he feels anxious to learn faster, need not worry about the criticism of *those who do not read mechanical papers, at least*, for he is in a fair way to outstrip them all, even if they did serve a regular apprenticeship.

S. W. Goodyear.



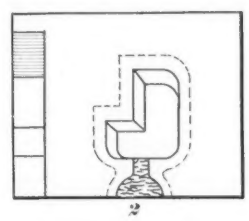
Holding Valves and Cages.

Laying Out a New Die.

Editor American Machinist:

I have been a reader of the American Machinist since the issue of No. 1, volume 1, and frequently have seen articles in it upon which I should like to comment, but have failed to do so, or to even give my ideas on any subject—preferring rather to learn from others.

I have lately been at work in a (to me) new line, and find a great many new things, and, necessity is said to be the "mother of invention." I do not know whether or not the idea I want to give is new, but it is good in sinking dies. I had a top die to replace because of a flaw in the steel of the old one,



Laying Out a Die.

and it was a puzzle to me to lay off the new die, so as to have it square and match the lower die; the shape of which was as in sketch, and is for dropping jaws for pipe wrenches. Now, I desired to have the upper die square with the side marked 2; at least for convenience in setting in the hammer. The dotted lines represent the "flask."

My way of proceeding was this: Taking a piece of card board, a little thicker than the depth of the "flask." I cut it to fit down in same, then cut out inside of card with a sharp knife while it is in position, which will guard against running outside of the proper line. Then, having the face of the new die all freshly filed to insure no grease on the surface, I applied the two faces together with the piece of card properly fitted in the "flask" of the lower die. Then I clamped them together, to insure against moving by jar or otherwise, and filled the mould, as it were, with a strong solution of salt water, and after it was in from one to two minutes, I turned the water out, and allowed it to drain for about fifteen minutes. When I had taken the two blocks apart, I found as fine a tracing in rust on the new block as any man would desire to work to.

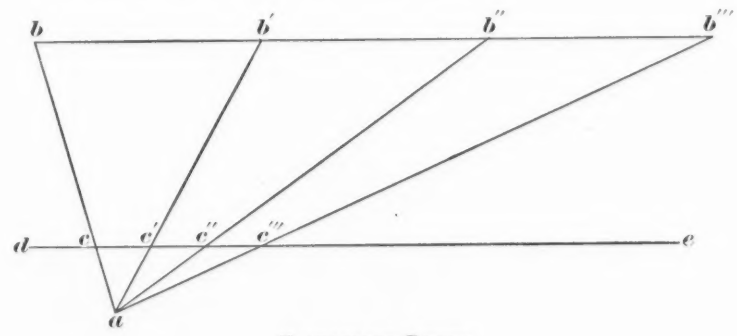
This rust working can be used to advantage in a number of cases, but care must be taken in separating the work so as not drag it.

H. Z. S.

Holding Valves and Cages for Grinding.

Editor American Machinist:

The usual way of holding steam-pipe joints, locomotive pump valves and cages, and the like, for facing and grinding, is to insert a stick in the open part of the joints or cages; this method is very unsatisfactory, on account of the tendency of the wood to become loose, and the constant necessity of driving the plug tighter. It is not a mechanical way of working, and besides, I think that a worker in iron should use tools and appliances made of metal, as far as is possible and convenient.



Pantograph Points.

To improve an old method, and to overcome the above difficulties, I made a tool which answers the purpose admirably; a holder which maintains a firm grip on the valve or cage and is, at the same time, simple and easy to use. It will take several different sizes of valves.

To make one the size of mine, take a piece of $\frac{3}{8}''$ gas pipe, 8″ or 10″ long; about $\frac{1}{4}''$ from one end, drill three holes ($\frac{1}{4}''$ tap) equidistant from each other, and at right angles with the axis of pipe. After tapping out, insert $\frac{1}{4}''$ studs, allowing them to meet in the center of the pipe and jambing them tightly against each other. It will be found of advantage to carefully caulk the studs inside and outside of pipe, or, they might be soldered together inside.

Then make three nuts (hexagon or square), as per sketch, making dimension, x, equal to the length of stud outside of pipe (in my case about $\frac{5}{8}''$). They may be made of steel or of wrought iron. On the other end of pipe cut a thread about half an inch in length. Take a piece of $\frac{3}{8}''$ gas pipe, flatten it in the center, drill and tap a hole through the flat portion and screw it on the other pipe. This forms a T handle for the holder. To prevent this handle from turning in use; the upright may be expanded against the horizontal part with a cape chisel.

In operation, the holder is held in position and the nuts screwed outwardly until they bear against the inside of the valve, and then made secure with a small wrench.

Another and probably better way to make this holder, would be to have the upright forged solid with the three studs at the base. The upright could then be suitably covered with a wood handle in the same style as an ordinary monkey-wrench, as in sketch.

Wm. Y. Schmucker.

Reading, Pa.

Pantograph Points.

Editor American Machinist:

Having occasion to use the pantograph as a reducing motion between crosshead and indicator, on two or three different styles of engines, I gave the subject of how best to apply it some study. I found it treated in some books and papers, mostly all of which give directions that are unnecessary.

The American Machinist, of Dec. 27, 1879, contains an article by "Chordal," which, among other things, says that "the stake socket must be directly opposite crosshead socket when the latter is at mid-stroke." Thomas Pray also gives explicit directions that "the stationary socket shall be so placed that the crosshead socket shall travel past it as far one way as the other, and says the diagram is worthless unless it is so." I thought there would be a good many men going by these authorities who could save time and trouble, also have their indicator cord lead off more convenient by trying some other way.

The action of the pantograph is such that, if it is extended or closed up all points on the center line travel through space in proportion to their distance from stationary pivot, also it makes no difference where the stationary socket is placed, whether some distance from beginning of stroke or at any point opposite the stroke, or directly in line with the stroke; all points on the center line of pantograph travel parallel with stroke.

For let the lines ab, ab', ab'', ab''', represent the center line of pantograph in four different positions of crosshead, the distance between b and b', b' and b'', b'' and b''', being the same, the distance between c and c', c' and c'', c'' and c''', is also the same, c being the point where cord peg is attached, and the line ac is $\frac{1}{4}$ of ab, the line ab' is longer than ab, $\frac{1}{4}$ of the difference between these two lines, added to ac, gives us the line ac', so also with the other lines, and the line $d\ e$ produced through points $c\ c'\ c''\ c'''$ is parallel to $b\ b'''$.

This being true, when the stationary pivot is as in the case illustrated, it will be true for any other position.

Draftsmen and surveyors use the pantograph to enlarge drawings, maps, etc., as the point b describes an enlarged figure traced by c.

The instrument can be used in a vertical plane as well as horizontal; in fact, it is a good deal like the improved guide pulleys upon indicators; the operator has the choice of any point in a vertical or horizontal circle, as well as any point in a circle that will bring the center line of pantograph parallel with the stroke, to place his stationary pivot in

order to have his cord lead in line of travel of cord peg and indicator.

The main thing to be careful of, is to see that there are no bending strains or cross-twists brought on the instrument.

I have found that in the majority of cases it is most convenient to place the stationary socket about in line with the stroke, so the pantograph will simply open and shut, getting a short cord with no carrier pulley by so doing. However, as it is now made, it cannot be used in this way on an engine which has much over three feet stroke.

Dunkirk, N. Y. J. A. Hutchinson.

Laying Out a Spiral Gear.

Editor American Machinist:

In the American Machinist of Jan. 30, Mr. Barrows tells how to lay out and make a templet, by which to work out spiral or worm gearing. He says, "by that method it would come correct at pitch line only." I have thought of a way by which it would come right in all directions. Taking a spiral gear, for instance; I consider it to be a screw with as many threads as there are teeth to the wheel.

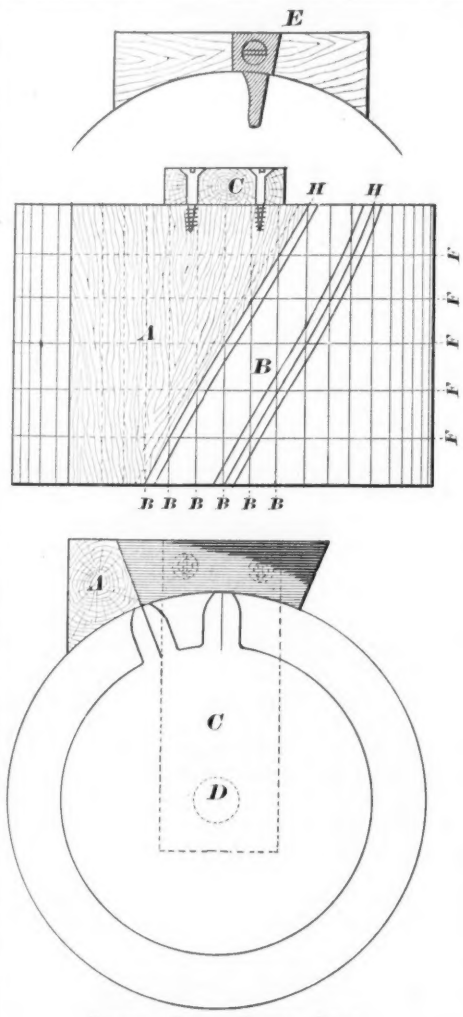
In making such patterns, the first thing to be determined would be the pitch of the screw, or spiral; that is, in what length of face the teeth would extend around the diameter of the wheel once. In my sketch I have taken a pinion 4″ pitch diameter, 16 teeth, 3″ face, the pitch of spiral or screw to be 24″.

After turning off teeth and marking pitch line on both sides, space off, and lay out teeth at one end. Now take a block of hard wood about 3″ wide; and fit same to outside of wheel, as cut *A*, and cut off to exact length of width of face.

Now, space off outside circumference of pinion into as many parts as you choose, say 48, transfer as many of those spaces to the block, of course on concave side, and square across as seen marked at *B B B*. Then divide pitch of spiral or screw into the same number of spaces and mark as many of these on the block, which will give the lines *F F F F*. Now, we have a number of squares on the block; by lining across them from one corner to the other, until the whole width of face is reached, you obtain line *H*, which is the exact angle of tooth as it runs across face of wheel. Cutting the block closely to this line and fastening same to piece of wood, *C*, which is made to work in a center, *D*, you are now ready to transfer centers of teeth to the other side of the wheel, laying them out and marking top faces of teeth with same templet.

Now we can proceed to work out the teeth to templete *E*. Closely working to the lines, I think we thus obtain a pattern as near correct as can be worked out of wood.

J. D. Ehrmann.



Laying Out a Spiral Gear.

Contraction and Expansion of Steel.

Editor American Machinist:

The paper from H. M. Howe, which was presented in your issue of February 20th, leads me to recount some experiences with the contraction and expansion of steel during the hardening process. The most serious of these is not yet two days old, but will be described first. The necessity has just occurred in my practice to produce interchangeable punches and dies for forming, from sheet metal, nine-pointed stars, $1\frac{1}{16}$″ diameter. These stars are punched from No. 22 band iron, and the points are required to be as sharp as it is possible to get them. The punching is to be done at the rate of 100 to 125 stars per minute from ten to twenty-two hours a day and in various parts of the country. So much for the requirements. My method, briefly, is to make for the punch a tool-steel cylinder 4″ long and $1\frac{1}{8}$″ diameter, and to flute it in a milling machine so as to have nine leaves or blades having an angle of about 41° or 20° 30′ each side of radius. I have made a mill that will leave these blades sharp just when a depth is reached that leaves the center body of the punch $\frac{3}{4}$″ diameter. In my innocence I figured that I could make a die (or a thousand dies) to fit these punches so as leave no appreciable bur on the star when punched; to send these punches and dies to different users of machines requiring them; to have users grind off the end of punch to sharpen it and to advance the same as needed until about $2\frac{1}{2}$″ were worn off. The die is made $2\frac{1}{2}$″ diameter, $\frac{3}{8}$″ thick, turned round and having a a conical periphery adapted to be held in a circular "dove-tail" follower.

Now, starting out with a hole in the finished die-blank of $\frac{3}{4}$″, it seems easy to make radial slots or notches in this hole exactly the counterparts of the blades on the punch—and so it is while the die is soft, but now comes in the expansion and contraction business and with it abundant room for expedients, theories, and schemes.

Thus far I have made three punches and two dies. The first pair hardened, fitted splendidly, the second die (same brand but different bar of steel) shrunk so much that it had to be annealed and filed to allow either punch to enter; the second hardening shrunk it more than the first and left it still too small for the punches and so on *for five consecutive filings and hardenings* before I became bold enough to file away sufficiently so the die came out of the water large enough for use. During these operations the die lost fully .03″ in the outside diameter. It should be stated that the punch has a $\frac{1}{2}$″ hole through its axis.

I started out by stating that I would recount "some experiences," I will take that back and let this one experience suffice now.

Meantime I will add that I am situated as was the boy digging for the woodchuck, "I've got to" solve this problem, and if I find anything connected with it that is worth relating I shall give myself the pleasure of sending it to you. C. C. Hill.

Chicago.

Moulding Blast-Furnace Pans or Hoppers in Green Sand, Without Patterns.

By Geo. O. Vair.

This casting, of which the method of moulding is herein described, is not shown because it involves any extraordinary amount of skill in the art of moulding; although there may be some points practiced that will be of assistance to others doing a similar class of work. My object is more to show what make-shifts moulders have to use sometimes in place of good appliances. The rigging here shown, I used in a foundry doing rolling-mill and blast-furnace work. Previous to making this casting they had used full patterns for such work, consequently there was no spindle or seat in the shop. The proprietor of the foundry had been told several times that it would be necessary to have a spindle turned up, so as there could be a seat cast (as the usual method of making a seat is to mould it in open sand using the tapering end of the spindle for a chill, and knocking it out while hot), but, as is often the case, when anything is wanted for the moulders, it was neglected until the casting was urgently needed, and the foreman notified that the casting had to be made "spindle or no spindle." So to get out the casting the best way we knew how, the following rigging was used:

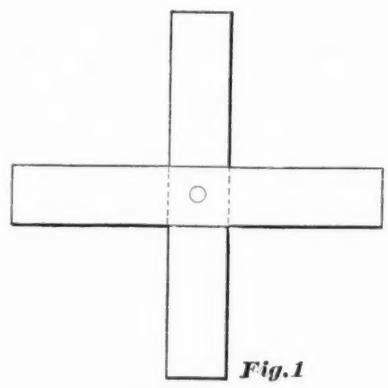


Fig. 1

Fig. 3

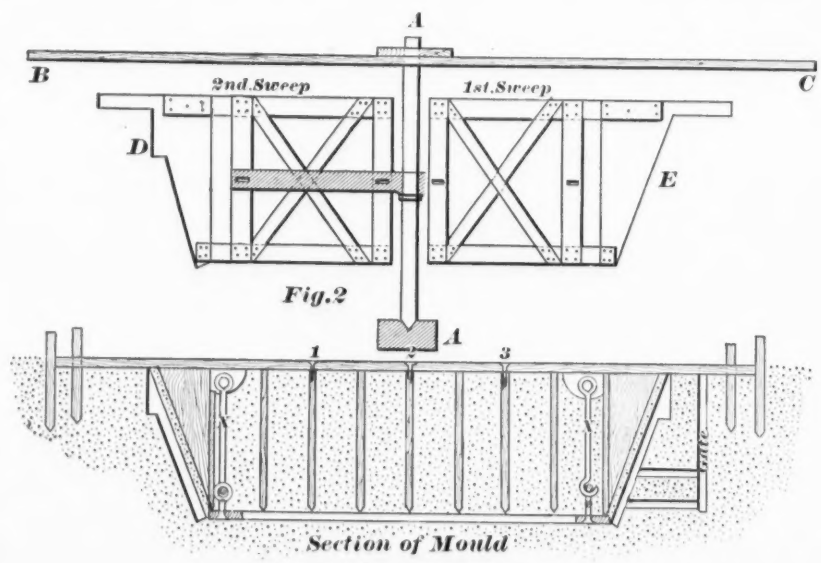


Fig. 2

Moulding Blast Furnace Pans.

The spindle used, was a piece of 2″ round iron drawn to a point. The step *A*, Fig. 2, was part of a casting found in the scrap heap, in which was drilled a countersink for point of spindle to work in. The top support for spindle consisted of two oak planks laid at right angles to each other, with hole in center to admit spindle, the plan of which is shown in Fig. 1, and at Fig. 2 is seen sectional view of same. The ends of the planks at *B* and *C* are rested on flasks or wooden blocks, and weighted lightly at first with pig iron until the spindle is plumbed up, after which, more pig iron is added, until the planks are secure against moving from any jars in consequence of using the sweeps. The size of this pan was 8 feet 10 inches at the top and 7 feet at the bottom, and the depth 30 inches; weight of casting was about 5,000 pounds.

The cuts *D* and *E* show the wooden sweeps for sweeping the inside and outside of mould. After sweeping up the shape of the inside, instead of using parting sand or paper to make a joint, we had the pattern-makers make staves as show in Fig. 3. Enough of these staves were made to complete the entire circle of mould; the staves were made same length as depth of joint, and about $\frac{1}{2}$ inch in thickness.

They were made a loose fit, being at places from $\frac{1}{8}$ to $\frac{1}{4}$ of an inch apart. I don't think this method is practiced by many, but I think it is a good plan for a lift of over two feet, as the staves can be made about as fast by the pattern-maker as paper can be nailed on the joint by the moulder, and it insures a better lift, also makes less finishing on the mould, as it obviates gagger and rammer marks.

After setting in lifting ring, the wooden basket is put in and rammed up. As will be seen by sectional view of mould, it was not necessary to lift, with the cope, the large bulk of sand contained in the wooden basket, therefore the cope was lifted first and separately, and to guide out and in the core.

A straight edge was fastened to top of basket with screws as at 1, 2 and 3, the same being staked at the ends as shown. This is not a very substantial guide, but with the crane properly adjusted it will work satisfactorily. In ramming up the cope there were several vacant spaces left between the bars so as to admit of wedges being inserted between the bars of the cope and those of the basket, the cope bars on top were also wedged from iron bars supporting weights for holding down flask; this prevents the melted iron from raising the core while the casting is being poured.

Rolling Mill for Cruciform Sections.

The use of cast iron for building purposes, columns, stanchions, and girders, says *Engineering*, is gradually, but surely, diminishing. Experience and experiments alike have shown conclusively that even under ordinary conditions, cast iron is, owing partly to its mode of production and partly to its low tensile strength, an unreliable material, especially in hollow sections. Columns with the material unevenly distributed, with flaws and blisters in their comparatively thin sides, have frequently failed under little more than ordinary loads, and in case of fire, cast iron is more unreliable still in consequence of its tendency to split and crack when a jet of water is impinged upon it while in a heated state.

For columns and stanchions, built-up structures have so far almost invariably been used, and for years angle, channel, and joist irons, in combination with plates, formed the only available material. The famous Phœnix column was a considerable improvement in this direction; in it, four or more segments are united by external flanges into a circular column having external vertical ribs from top to bottom. Cruciform sections have been only obtainable of comparatively small dimensions and of decidedly unsuitable shape, showing a distribution of material far from economical for the intended purpose. All these wrought-iron structures require considerable labor in fitting and riveting, and are consequently rather expensive, and in the end often but indifferently adapted for their purposes.

With a view of developing this evidently wide field, Mr. Hugo Sack, of Duisburgh, has

designed and patented a rolling mill for rolling cruciform sections of large dimensions and of any desired distribution of material. Some of the forms proposed by him are shown in the small sections in Fig. 12, annexed, from an examination of which it will be admitted that these sections offer admirable opportunities for the attachment of brackets.

Mr. Seaman, of the Phœnix Rolling Mills, Pittsburgh, has designed and erected a mill for the same purpose, which is already turning out similar sections.

Of Mr. Sack's mill we publish illustrations, but before entering into a description of it, it will be well to make clear the general principle of its action. The mill is designed as a reversing rolling mill, and to be capable of turning out sections of from 8 in. to 14 in. across. If iron is to be used as the material the bloom or packet is first passed through ordinary roughing rolls in which a crude cruciform section is given to it, previous to it being introduced into the cruciform mill. Where mild steel is the raw material, ingots may be cast of suitable section. The train will be quite capable of rolling these heavy sections from rough ingots, and of finishing them completely, all parts of the mill being made adjustable, but it is anticipated that very soon a set of finishing rolls will be put up, which will be very much simpler and cheaper, owing to the fact that no adjustment will be necessary for the rolls. The principle of this new mill will be best understood by reference to Fig. 13 annexed, in which *A A* represent two horizontal rolls, mounted as usual in vertical frames, while between these rolls run two loose rings, mounted upon vertical shafts, in such a manner that the point of closest approach of all four rolling surfaces is in one vertical plane. The rolls are driven in the usual way. The rings only answer the purpose of retaining the rolled material in the desired shape, and they rotate in consequence of surface friction against the rolled material only.

It is very essential when rolling these cruciform sections, that the leading in and out of the rolls should be very carefully done, and ample provision is made for this purpose. Two correctly-shaped guide pieces forming a kind of trumpet-like mouthpiece, are mounted upon the same trunnions as the cradles and their distance is thus adjusted by the levers. They are, moreover, attached to the horizontal swinging frame by bolts working in slots, and being mounted on this swinging frame, they partake of its vertical adjustment. Just outside these mouthpieces are rails, attached to which, are semicircular open troughs, in which the section is turned after each passage through the rolls, and then pushed into the mouth-piece guide.

Fig. 14 annexed, represents the gradual change in section which a rough cruciform ingot undergoes in its consecutive passes through the mill; it will be noticed that care has been taken to avoid the undue formation of fins, and where this is impossible, it is got over in the next pass. Returning the rolls is, in the case of this mill, very simple, since only one section has to be operated on.

At present no data are available as to first cost and maintenance of such a mill as we have been describing, but Mr. Sack confidently claims a very good return for it, and bases his claims on the assumption, that first cost and maintenance will not exceed those of a good ordinary reversing train, and moreover, since large sections, varying from 60 lbs. to 100 lbs. per foot run will be rolled on this mill, it will amply repay its cost.

A big icicle, applied endwise to a hot hammer-face, will often harden that tool when the steel refuses to respond to a dip in the water bucket.

Don't make the boys chip too many castings. Much good machinist material has been made into poor clerks and worse lawyers by six weeks with the scratch brush. Let the boys "expand" up among the lathes.

Brazing and Welding Iron.

BY JAMES F. HOBART.

In brazing iron, as in several other branches of iron-working, the quality of the job depends much upon how we get ready to do it. First, bring the two pieces of iron to such a position that they *fit each other*. We may braze two pieces of iron when they lie within one-eighth of an inch of each other, but it will not be a good job. We simply fill the space between the parts with brass, instead of firmly uniting them, as it is desired to do.

The quality of the work depends upon the intimate contact of the two surfaces. No matter how close they lie, the brass will find its way between them. We may, for example, drill a hole in a piece of iron, turn a plug to drive tightly into the drilled hole (which may be reamed if desired), and rivet the plug thoroughly on both sides of the piece of iron, yet, upon melting brass upon the rivet-head, with a liberal flux of borax, the brass will flow through the plate beside the rivet, and show itself in the form of a circle entirely around the rivet-head on the under side of the piece of iron.

This example shows how brass will insinuate itself between two pieces of iron, but, in order to secure this result, the surface of the iron must be clean and bright.

Two pieces of iron will sometimes unite with the brass, when one or both surfaces are covered with rust. It is possible, but not a sure thing by any means. The heat *may* cause the coat of oxide to scale off, but more often the attempt to braze, under such circumstances, will be a failure.

After cleaning the surfaces to be brazed, bind them firmly together, either by riveting or by means of iron wire. Sometimes, when small articles are to be brazed, they may be held in a pair of tongs. In all cases, hold them by some means, or the two pieces of iron will be apt to separate when the brass melts and runs between them, thus making a thick seam of brass and a poor job.

Put borax on the joint before heating the work. By so doing, a scale of oxide is prevented from forming, which it would surely do if the bright iron surfaces were not protected by a flux..

The brass may be used either in the form of filings or as a solid piece cut from a thin sheet.

Care must be used in selecting "brass" for brazing. The term "brass" is used to designate various alloys of copper and zinc, ranging from almost pure copper to pure zinc. Soft "yellow brass" will probably give the best results for wrought iron, but for brazing cast iron (which is a somewhat hazardous job, usually) an alloy containing more copper has been found to give good results.

Common brass contains about 75 per cent. of copper and 25 of zinc. "Hard" brass has 97.3 copper, according to *Haswell*, 6.4 zinc, and 14.3 tin.

Brass containing tin does not give as good results when used for brazing, as that composed entirely of zinc and copper.

"Soft" brass has 66 per cent. of copper to 34 of zinc. By using this alloy, which has more brass than is necessary before being melted, we are apt to secure a very good quality of metal after the brazing operation has been performed, as by melting the brass we are sure to lose part of the zinc by oxidation.

When the flux and brass have been placed in position upon the joint (the borax always being used powdered), apply heat either by the blow-pipe, or by means of an ordinary blacksmith's fire.

When applying the heat, take care to do so evenly and not too fast. If the joint is a short one, be sure to heat the whole and not leave a cold spot at one end, while other parts are burned.

If the joint is a long one, braze in sections, the length of which must be governed by the size of the fire. It is possible to braze any length over a common fire by working it in sections of six or eight inches at a time.

Watch the brass closely as it approaches the melting point. With a small rod of iron, keep the brass well over the joint, and the moment the brass "runs"—if the job in hand is sufficiently heavy to allow it—brush all superfluous brass from the joint and lay the article aside to cool slowly. Do not dip it in water. It *may* cause the iron to harden, or it may "blow" the brass out of the joint.

Avoid the use of two much brass. Like a glueing-job, the least left in the joint, the better the job.

In small shops, it is well known that much work must be "rigged up for," and upon the faculty of "rigging up," depends much of the shopman's revenue, and also, we might add, his reputation as a "good machinist."

It sometimes happens that a three-foot "chunk" must be welded on the end of a shaft of perhaps ten or more feet in length. The "chunk" may be 5″ in diameter and the shaft 4″. If we are provided with a good blower, two forges and a power hammer, we can easily do the job, but if the blower is too small to run more than one fire in first-class shape, and 14-pound sledge hammers must do the welding, then we must rig up a little in order to do a good job.

We must heat both pieces in one fire, and the welding must also be done in the fire. We will rig up bearings to hold both pieces, and at the same time, keep them level and in line, so that they both lie straight with each other.

The first operation was to char a bushel or two of coal; then the fire was cleaned out and the largest shaft put in. In a short time the other piece was put in and the fire well built up around them both. Two men were kept at each piece, and a third man at the further end of the ten-foot piece. The shafts were kept constantly turning, so that all sides might heat equally.

While the heating was going on, two ropes were made fast to convenient beams overhead, and a piece of 3-inch shaft, about 6 feet long, was made fast to the ropes in such a position that it could be swung endwise about two feet and would strike fair against the end of the larger shaft.

When the shafts began to get pretty hot, a hole was dug down to them through the top of the coal on the fire, so that the two shafts could "felt of" with the poker. A little practice will soon enable one to judge the degree of heat a piece of iron has attained, by touching it with a small rod of cold iron. When the "sparks began to fly," sand was introduced through the hole in the coal; during all this time, the two pieces were kept slowly turning. At last the right degree of heat was obtained. The sparks came out looking white, the iron felt "mellow" when touched with the poker, which would "stick" about as quick as it touched the hot iron. The coal had all burned from between the ends of the two shafts. They were shoved together and four men lightly applied the "ram" formed by the piece of shafting hanging by the two ropes.

Lightly at first, the blows were put on, to let the ends, which had been made convex, come together gradually, center first, and also to give the scale of oxide and flux a chance to work out.

Harder blows were next struck. The blast shut off from the fire and the men fairly "jumped" the swinging ram for half a dozen blows.

The shaft was then swung by the crane to the anvil. It had "stuck" and it was "upset" 3″ at the joint. Five of the men put their sledges on the weld. It soon was reduced; at the same time a number of blows were given it endwise. A few minutes' work with a swage, with the shaft laid in one groove of the "hog," soon brought it to size and a finish. The job was well done with one heat. It showed no sign of weld, or burning at the junction of the two pieces.

The *Railway Register* says: "It is understood the North Chicago Rolling Mill Company is engaged in making ten thousand tons of steel rails to be laid side by side with English hammered rails as a test of superiority. The English rail is to form one side of the road and the North Chicago Rolling Mill Company's rail, the other side.

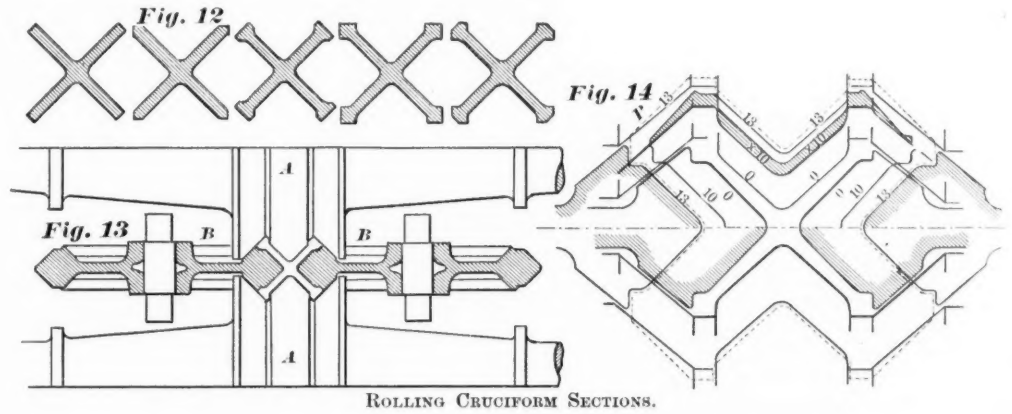
In critical times one of the greatest obstacles to business improvement is the tendency to cut prices. The opinion that further decline in prices, when they are already low enough, will stimulate buyers, seldom holds good in the machinery business. Buyers at such times are almost certain to look for a further decline rather than to take advantage of the present. When prices of machinery are as low as they are now, and when there are good reasons why business should be good, there is nothing so likely to bring this about as an advance in prices. An advance at such a time is interpreted to shadow the probability of further increase, and buyers wisely conclude to buy before that happens. Lower prices generally mean lower wages and this of itself acts injuriously on general business. Just at this time a general advance in the price of machinery would be of advantage to the trade.

A. C. Rice, well known to Eastern mechanics as being, for several years, connected with the Holyoke Machine Company, and for the past three years superintendent of their works at Worcester, has accepted a position as hydraulic and mechanical engineer with the Stillwell & Bierce Manufacturing Company, of Dayton, Ohio.

The thinking man is the man who succeeds. Any man can conjure up ideas, but the man who calmly and quietly thinks the matter to the end before entering upon the road thus opened, is the man who gets along better than he who rushes pell-mell into the first lane he finds, and often brings up against a big stone in the "little end of the horn."

Dating Trade Catalogues.

Out of the large number of machinery catalogues we receive, a considerable proportion bear no external mark to indicate that they are of recent issue. Doubtless on this account some such are not preserved by parties receiving them. New and enlarged editions can be so readily issued from time to time, that it would seem advisable to add to the inducements to preserve such publications for future use, whenever it can be done by attention to such a simple matter. Where parties find several copies of a manufacturing concern's catalogue or circular in their possession, with nothing to indicate "which is which and which is t'other," they are liable to resolve the doubt by retaining the wrong one or discarding all.



ROLLING CRUCIFORM SECTIONS.

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CONTENTS.

	PAGE
Richards' Combination Planer and Shaper	1
The Pleasures of a Machinist. By Prof. John E. Sweet	1, 2
Baltimore Meeting of Electric Light Association	2, 3
The Belknap Straightway Check Valve	3
Improvements in Casting Steel	3
Rotative Speed of Self-contained Engines. By W. H. Hoffman	3
Engineers' Club of Philadelphia	4
Gmelin's Cupola	4
Inventory Valuation of Patterns	4
"Drawing Air" Gate-stopper and Chaplet-gauge. By Thomas D. West	4
Letters from Practical Men—A Correction—Different Methods of Learning a Trade. By S. W. Goodyear—Laying Out a New Die—Holding Valves and Cages for Grinding. By Wm. Y. Schmucker—Pantograph Points. By J. A. Hutchinson—Laying Out a Spiral Gear. By J. D. Ehrmann—Contractioon and Expansion of Steel. By C. C. Hill	4-6
Moulding Blast-Furnace Pans or Hoppers in Green Sand Without Patterns. By Geo. O. Vair	6
Rolling Mill for Cruciform Sections	6, 7
Brazing and Welding Iron. By Jas. F. Hobart.	7
Predicting the Future of Business	8
An "Engineering Era"	8
Not the Way to Settle Disputes	8
Enlarging the Erie Canal	8
Literary Notes	
Questions and Answers	8, 9
Manufactures	9
Machinists' Supplies and Iron	9

Predicting the Future of Business.

When business men meet, one of the most interesting topics of conversation that can be started, is usually the business situation and the business prospect. So long as forecasts of the future, whether favorable or unfavorable, are mainly predicated upon the present, with only incidental reference to the past, this is well. But many such forecasts are mainly predicated upon the past, with little more than incidental reference to the present. The doctrine of unvarying cycles of depression of an orderly succession of upward and downward movements in general business, has thousands of believers.

By way of illustration, it may be noted, that an Ohio farmer, doubtless a shrewd compiler of statistics, and a quick-witted observer of events, publishes a book of such forecasts, and great numbers of keen business men, in looking over the prospects of business for the future, are more or less influenced by them. Some wholly or partially accept his theories, because they really have faith in them, on account of the more or less successful issue of previous predictions. Others give credence because they think enough people will be governed by them, to practically aid in making the business of each year measurably correspond with the published prophecy. It is safe to say, by way of reminder to either class of believers, that if our shrewd Ohio farmer had really and unerringly the gift he claims, the field of financial speculation would welcome him as a conqueror, against whom none could stand. He would not long remain an Ohio farmer.

The perilous thing about all business prophecies, which are based mainly on the history of past years (and such must of necessity go back at least one or more decades) is that they attempt, as do some economic theorists, to reason from one set of circumstances to events growing out of circumstances widely different. For example, to predict a financial panic as to occur in a given year, partly because such panics occurred in 1837 and 1857, is to ignore countless changes that have since taken place. A case in point is the events that have occurred in the transportation business of the country, largely due to the general use of steel rails, which have by comparison, practically brought Colorado and Dakota within a few hundred miles of the Atlantic seaboard The carrying capacity of myriads of freight cars has doubled, and bids fair soon to have trebled. Improved means of using steam on land and sea, improved machinery in every branch of manufacture, the spread of intelligence due to the development of railroads and telegraphs, of newspapers and exchanges, to say nothing of the use of such minor agencies for facilitating business as telephones, and type writers, and fast mails, and improved methods of selling—all these, and a thousand more changes, have intervened to render attempts at historical prophecy abortive. Let us all be well enough satisfied with the present outlook to accept it heartily, and go to work to make it what we would like it to be. But beware the art of the Ohio farmer. As matters go, a Benner's lot is not a happy one.

According to the report of the Commissioner of Patents the balance of receipts over expenditures for the year 1885 was nearly $164,000. The Patent Office business has been going on for years showing a handsome profit to the Government, and in the meantime the Commissioner is asking for much needed facilities for prosecuting the work of the office. First, there is the Commissioner asking for money contributed by patentees to expedite their business, then there are the patentees complaining, justly we think, that their business is not promptly and properly done, and lastly, a faction, headed by some of the daily press, calling for changes in the patent laws that will discourage invention. The inventive genius of this country has done more to build up manufacture than it will ever receive credit for; inventors are entitled to better facilities at the Patent Office than they have at present, particularly since they would be provided by money which they had contributed.

An "Engineering Era."

A mechanical engineer has taken the trouble to bring to our notice certain specimen copies he has received of a so-called civil engineering paper, accompanied by a publisher's circular from which we take the following:

We take pleasure in sending you the "——" for the months of February and March, without expense to yourself, as specimen copies. It is our hope and belief that within that time we shall become to you a "household necessity," filling as it were, a long felt want, and that you will desire us to continue our semi-monthly visits. At the expiration of the time specified, should we hear nothing to the contrary, we will add your name to our list of subscribers on the principle that "silence gives consent."

Inquiry showed that several individuals connected with this office also received the same impudent proposition, the specimen copies sent bearing date December 31, 1885, and January 14, 1886.

Practices of this kind are a disgrace to journalism. Machinery establishments have large numbers "of trade papers" sent them, which they never ordered and never read. A "circular" such as the above, sent with the first copy, is very likely to be overlooked or never seen. Placing the names of the parties on the subscription list of such a publication, therefore, on the principle that "silence gives consent," and expecting payment for papers thus sent from busy men who either had no previous knowledge of the cool proposition, or did not take the trouble to order the paper stopped, is an act of effrontery, which should receive due attention.

The discussion on the report of the committee at the Baltimore meeting of the Electric Light Association, which we publish elsewhere in this issue, shows about the usual division of opinion as to the relative economy of high and low speed engines. The inference to be drawn from current opinion on this subject is that either a high or low speed engine will give economical results according to its construction, and that either may be best under different circumstances.

Not the Way to Settle Disputes.

A bill is before the Legislature of the State of New York, which if it were to become a law would, metaphorically, put its foot into what has already been brought about toward the end of settling disputes between employers and employes by arbitration. The bill proposes to make such settlement compulsory, and to create state and local boards of arbitration having jurisdiction in such disputes. If such a law were enacted and declared constitutional, it would be distasteful alike to both parties, and they would cordially join forces to evade it. We believe in arbitration, but to accomplish any good purpose it must be mutually agreed upon by both parties to the dispute. There must be nothing of coercion about it—no officious meddling of the state. Left alone there is good reason to believe that arbitration would gain in favor, and that eventually most differences between employers and employes would be satisfactorily settled through it, but the senseless attempt of any state, or general government, to interfere in the matter would be justly condemned.

There are two ways of competing in manufacture; one is making the article manufactured so good that it, through this quality, maintains its hold in public estimation; the other, to make it so cheap that the low price for which it is sold will keep it in the market. The former of these plans is, we believe, likely to prove the most satisfactory in the end, and is the one American manufacturers are given to following. Corroborative evidence of this may be found in a recent article in the *Leeds Mercury*, in which it takes British manufacturers to task for lack of character in their products. Speaking of Sheffield, the *Mercury* says: "She is between the upper millstone of American superiority and the nether millstone of German inferiority." We accept the upper millstone as being typical American manufacture in the small hardware line, to which the *Mercury* refers.

Enlarging the Erie Canal.

The State of New York has an important work in view in the enlargement of the Erie Canal. It is really a work of National importance, as its accomplishment would benefit other parts of the country scarcely less than the state of New York. It is absolutely essential to provide cheap transportation for the farmers of the wheat-growing states who must reach the seaboard with their grain, and the Erie Canal is the most desirable route. But the cost of transportation must be lessened to them. Already there is evidence that they are looking towards the Welland Canal as an outlet for wheat on its way to Europe. To oblige them to ship in that direction would be a very decided injury to the interests of New York state and city, and would not be according such privileges as they should have. The probability of a large portion of the grain trade being diverted in the direction named, may be averted by providing a proper outlet through the Erie Canal. Competent engineers say that by this means the actual cost of transportation would be lessened by nearly one-half, to say nothing of the increased facilities for quick shipment. In this matter of transportation, the farmer has the same right to expect protection that the manufacturer has in manufacturing. And it is equally to the general welfare that he should have it.

There is a good deal of misapprehension as to the capacity of a waterway such as the Erie Canal enlarged, would be for moving freight. Some idea of this may be had by considering that a canal-boat would carry as much freight as a fair-sized freight train, and that if necessary the interval between boats reaching tidewater need be only that of the time required to pass the slowest lock.

Literary Notes.

The popular work, "Locomotive Engine Running and Management," by Angus Sinclair, is used as a text-book in the examination of firemen for promotion on the Central Pacific Railroad.

We are in receipt of the twelfth volume of the *Sanitary Engineer*, handsomely bound, containing the issues from June to November, 1885, inclusive. It contains a large number of practical articles on subjects of general interest connected with the specialties it treats, and will be found an instructive addition to the library of the practical man as well as the engineer.

QUESTIONS AND ANSWERS.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials, nor location will be published.

(90) H. D., Philadelphia, Pa., asks: Have you any rule for the feed and speed of twist drills? *A.*—You will find a table of speeds, and a rule for feed in the AMERICAN MACHINIST of July 18, 1885.

(91) Machinist, Crawfordsville, Ind., asks: Is there any power gained in hauling a heavy freight train up grade by allowing the drivers to slip around? *A.*—When the slip becomes perceptible, there is great loss instead of gain.

(92) Engineer, Newark, N. J., asks: Where is the Lincoln's Inn Dining Hall, in which the high-speed engine referred to in your issue of Feb. 20 may be seen? *A.*—The paper from which we quoted is published in Glasgow, Scotland; we suppose the hall referred to is in London, Eng.

(93) O. S. W., Watertown, N. Y., asks: What is the most approved angle for taper journals? I am aware that such an angle has been adopted by some engineers, and that it is a modification of the Schiele curve. I would like to know the angle, and if the shoulder may not be omitted when there is no great end thrust? *A.*—In the AMERICAN MACHINIST, of Sept. 9, 1882, will be found drawings and a description of such a journal. We should not omit the shoulder.

(94) L. D., Montour, Iowa, asks: How can I obtain a license as stationary engineer without going to a distance? *A.*—You cannot obtain a license without appearing personally before the examiners. Then it will only cover the special locality over which the examiners have jurisdiction.

(95) A. A., Wappinger Falls, N. Y., asks: In building a large chimney, should the inside at the top be larger or smaller than at the bottom? *A.*—It is the present practice to give larger area of opening at the top than at the bottom. You will find examples in the AMERICAN MACHINIST of March 24 and May 19, 1883.

(96) C. M. H., Hudson, Mass., asks: Is there any way to tell at what point an automatic cut-off engine is cutting off, except by the use of the indicator? *A.*—Some kind of automatic engines have an attachment which constantly indicates the point at which they are cutting-off. Generally, however, it is determined by the use of the indicator.

(97) G. S. C., Smith's Falls, Ontario, asks: What ingredient can I add to glue in order to prevent its setting too quickly, and still not impair its strength? *A.*—It would probably answer the purpose to add a small amount of glycerine, or molasses, but a much better method is to heat the pieces to be glued. In this case, the wood being hot, the glue is kept melted until required adjustments are made.

(98) J. C., New York, asks: How much travel has a locomotive valve when reverse-lever is in mid-gear, and is there any way to overcome this mid-gear travel? *A.*—When the lever is in mid-gear the port opens to the extent of the lead, hence the travel each way is the lap of the valve plus the lead at mid-gear. There is no practical way of overcoming this with the valve gear in ordinary use on a locomotive.

(99) J. F. W., Charlotte, N. C., asks: Can you give me the composition of a varnish for protecting the bright parts of iron work, the polish to be seen? We have been using white lead, but it is too unsightly. Common resin, melted with a little cheap olive oil and spirits of turpentine will probably answer the purpose. It should be so mixed that it will not scale, yet admit of being easily removed by scraping.

(100) J. G. I., Ethel, Ontario, asks: 1. How to clean dirty brass tallow cups? *A.*—Use oxalic acid, or any good "brass powder," which is sold at nearly every hardware shop, for cleaning brass. 2. The cylinder-heads and other polished parts of the engine are badly covered with burnt grease. How can I get it off without scraping? *A.*—There is no better way. A hot solution of potash or soda will help the work, but prevention is better than a cure.

(101) F. D. W., Brooklyn, Wis., writes: I am building machines in which bevel gears are used as intermediate transmitters of power. I wish to increase their durability, and propose to increase the speed of the prime mover three-fold, so the intermediate gears will move three times as fast. What results can I expect from such change? Will the gears transmit the same amount of power with less wear? *A.*—As we understand it, the wear of the gears will be increased.

(102) W. H., Newburg, N. Y., writes: My experience teaches me that there should be some limit as to adjusting the packing in a steam-engine cylinder. Men are usually guided by their judgment, and nine times out of ten get packing too tight or too loose. Do you know of any rule giving pressure per square inch at which packing should be set out? *A.*—We do not know of any rule. We believe the judgment of the operator is always depended upon where adjustable packing is used.

(103) Steam Heating, Youngstown, Ohio, writes: Please oblige me by informing me through the columns of your paper in the following: With five pounds steam pressure, how many square feet or inches of heating surface is necessary to heat 100 square feet of glass on the roof, ends and sides of a greenhouse in order to maintain a night heat of 55° to 65°, while the thermometer outside ranges at from 15° to 20° below zero; also, what boiler surface is necessary? What is the best way to set pipes in a greenhouse, hang them or lay them down? Which is the best for the purpose to use, 2″ pipe or 1¼″ pipe? *A.*—We have referred the above to Wm. J. Baldwin, who answers as follows: "Reliable authorities agree that 1.25 to 1.50 cubic feet of air in an enclosed space will be cooled per square foot of glass as many degrees as the internal temperature of the house exceeds that of the air outside. In your case, then (between 65° + and 20° —), there will be a difference of 85.°, or, say, one cubic foot of air cooled 127.5° Fah. for each square foot of glass for the most extreme condition you mention. Multiply this by the number of square feet of glass and by 60, and you have the number of cubic feet of air cooled 1° per hour within the building or house. Divide the number thus found by 48, and it gives the units of heat required, approximately. Divide again by 953, and it will give you the number of pounds of steam that must be condensed from a pressure and temperature of five pounds above atmosphere, to water at the same temperature, and you have the number of pounds of steam that must be condensed in an hour to maintain the heat. If you now arrange effective coils of pipe, each square foot of surface will condense from one-quarter to nearly one-half pound of steam per hour, according as they are exposed, or well or poorly arranged, for which an average of one-third pound may be taken. According to this, then, it will require three square feet of pipe surface per pound of steam to be condensed. Proportion the boiler to have about one-fifth the actual radiating surface, if you wish to keep steam over night, and proportion the grate to burn not more than six pounds of coal per hour. With very slow combustion, such as takes place in base-burning boilers, the grate might be proportioned for four to five pounds of coal per hour. It is cheaper to make coils of 1¼″ pipe than of 2″, and there is nothing to be gained by using 2″ pipe unless the coils are *very* long. The pipes in a greenhouse should be under, or in front of the benches, with every chance for a good circulation of air. 'Header' coils are better than 'return-bend' coils for this purpose."

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

Power measured.–F. Van Winkle, 22 Cortlandt, N. Y.

Alt, Mechanical Engraver on Wood, 318 B'way., NY

T. M. Parker, Steel Stamps, Stencils, Hartford, Ct.

J. Clayton, Air Compressors, Rock Drills, 43 Dey st, NY

Edw. Sears, Wood Engraver, 48 Beekman st., N. Y.

Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.

Tack, Wire and Shoe Nail Machinery. Wm. A. Sweetser, Brockton, Mass.

Steel Shank, Wire Nail, Shoe Nail and Tack Machinery. Keith & Trufant, Campello, Mass.

Tack and Wire Nail Machinery, made by the Willets Mfg. Co., Providence, R. I.

The Best Upright Hammers run by belt are made by W. P. Duncan & Co., Bellefonte, Pa.

Light articles built to order by the American Sewing Machine Co., Philadelphia, Pa.

R. Dudgeon, 24 Columbia st., New York, Improved Hydraulic Jacks and Roller Tube Expanders.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.

"How to Keep Boilers Clean." A book mailed free, by James E. Hotchkiss, 86 John st., N. Y.

Pattern Letters and Figures to be put on patterns of castings. H. W. Knight, Seneca Falls, N. Y.

Selden Packing, for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., NY

Patent Attorney and Expert. Machine designs and details. Wm. H. Weightman, 82 Astor House, NY

Foot-power Machinery, for workshop use, sent on trial if desired. W. F. & Jno. Barnes, Rockford, Ill.

Lyman's Gear Chart. How to Lay Out Gear Teeth. Price, 50c. E. Lyman, C. E., New Haven, Conn.

Improved Labor-saving Upright Drills, 20-in. to 36-in., inclusive. Currier & Snyder, Worcester, Mass.

Engine Lathes, Hand Lathes, and other fine tools. Assortment large; prices low. Frasse & Co., 62 Chatham st., N. Y.

Curtis Pressure Regulators, Curtis Return Trap, Curtis Damper Regulator. See Feb. 13, p. 12. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys. Yocum & Son's Shafting Works, Drinker st., Philadelphia, Pa.

E. Merritt & Co., Brockton, Mass., established 1859, only manufacturers of a complete line of Tack and Nail Machinery. Send for circulars.

Files recut without drawing temper, about one-half usual prices; samples recut free; prices on application. The Acme Co., Collinsville, Conn

"Complete Practical Machinist," $2.50; "Mechanical Drawing Self-taught," $4. Books for workmen. Joshua Rose, Box 3306, New York City.

The Chandler Water Motor.—Five years successful trial has proved the Chandler Motor to be the most reliable and economical motor made. Built in six sizes, from ⅛ to 12 horse-power. Efficiency, safety and economy combined. Send for illustrated catalogue and price-list. Factory and warerooms, 132 Oliver street, Boston, Mass.

"Locomotive Engine Running and Management." By Angus Sinclair. Gives full directions about handling and repairing locomotives; instructs how to design valve gear and set valves; Westinghouse air-brake explained by aid of engravings. Price, $2. For sale by "National Car Builder," 187 Dearborn st., Chicago, Ill.

Every young man who aspires to be either a mechanic, merchant, or manufacturer, owes it to himself that he become thoroughly familiar with the writings of Chordal. John Wiley & Sons, 15 Astor Place, N. Y., have issued a new and enlarged 12 mo. edition of "Extracts from Chordal's Letters." Handsomely bound in cloth, with over 50 illustrations. Price, $2. Discount of 25 per cent. on orders for five or more copies.

MANUFACTURES

Bluffton, Indiana, is increasing its water-works plant.

F. D. Scribner has started a new machine shop at Norway, Me.

Auburn, Pa., is to have a shoe factory by Frederick & Co.

A steam saw-mill is to be built at Mendota, Va., by J. W. Frizzell.

A woolen mill will probably be built at Metamora, Ind., during the coming season.

A large steam saw-mill will be built in the spring at Canton, Me., by Gilbert Brothers.

The Merino Shoe Company, Kennebunk, Me., are fitting up a large shoe factory at that place.

A large factory is to be built at Allegheny, Pa., by Lindsay & McCutcheon.

William Rennie, of Pittsfield, Mass., is building a co-operative shoe factory at that place.

Wages have been advanced ten per cent. at the Ponemah Cotton Mills, Taftsville, Conn.

The Lake Company, Lake Village, N. H., are to build an additional cotton mill at that place.

The Salisbury Woolen Mills, Salisbury, N. C., which were lately burned, are being rebuilt.

It is expected that a grain elevator will be built at Buffalo, N. Y., by the L. S. & S. M. Railroads.

The Putnam Mfg. Co., Putnam, Conn., will put in a steam plant, to supplement their water-power.

The Brinn Mfg. Co., Dover, Me., contemplate an enlargement of their woolen mill.—*Industrial Journal.*

The Goodell Cutlery Co., Antrim, N. H., have recently put in a number of Beaudry upright hammers.

The village of Boenville, N. Y., Delhi, N. Y., Ellsworth, Me., Shoshone, Idaho, and Raleigh, N. C., are to have water-works.

The Berlin Iron Bridge Co., N. Y., will establish a branch at Binghamton, and has increased its capital from $100,000 to $200,000.

New foundries will soon be built by Mesien, Hertenstein & Co., Columbus, Ohio, and by the Metcalf Mfg. Co., Nashville, Tenn.

The Niles School Furniture Mfg. Co., Grand Rapids, Mich., will begin active operations in manufacturing about the first of March.

The Chattanooga, (Tenn.) Plow Co. are enlarging their plant. They will add new engine lathes and other iron-working tools.

The New York Central is about to increase the salaries of its conductors twenty-five per cent., making the maximum salary $100 per month.

The Chicago, Burlington & Quincy Railway Co. have recently added to the tools in their general shops at Aurora, Ill., a large Brown rubber-cushioned helve-hammer.

J. H. Williams & Co., 9 to 15 Richards street, Brooklyn, N. Y., manufacturers of drop-forgings, have issued a revised price-list, under date February 1, 1886, containing a number of changes in prices of wrenches.

Plans have been perfected for the enlargement of the West Shore car shops, at Buffalo, N. Y., for the use of the New York Central Sleeping Car Co. It is estimated that the changes will cost $200,000. It is expected that when the changes are completed 600 men will be employed.

David Thompson and M. B. Ryan, says the *Boston Journal of Commerce*, have leased the Jackson mill on Ship street, Adams Island, Cohoes, N. Y., and will begin to put in machinery for the manufacture of knit goods. A ladies' garment will be made, and about sixty dozens produced daily.

The Oneida (N. Y.) Carriage Works Co., consisting of Julius J. Smith, John Horth, Thomas Dapson and John Wolf, have bought land on Cedar st., on which they are to build a four-story brick block, 120x80 feet. They expect to have it in shape by the first of July, and will employ about 100 men.

The Holly Manufacturing Co., Lockport, N. Y., have issued three catalogues, one illustrating and describing very fully the Gaskill pumping engine for water-works, another the Gaskill fire hydrant, and the third containing detailed reports of trials of pumping engines erected by the company in different cities.

A machine-tool establishment writes us: "We have advanced our prices a little, and made some sales at the advance. We are stiffening all along the line, and things are undoubtedly getting better. We are putting on men every day, and inquiries are good. We know of lots of people that want to buy, and now is the time.

The Ohio & Mississippi Railroad has just closed an agreement with the citizens of Washington, Ind., to concentrate at that place its machine shops and car works, now located at Cochrane, Seymour and Vincennes; the latter are to pay $72,000 toward the construction of the new buildings, which are to cost not less than $150,000.—*Railway Age.*

The management of the Beaver Falls Car Works Company, Beaver Falls, Pa., whose buildings were destroyed some days ago by fire, has rented the unused machine shop of the cutlery works and the idle foundry of Rainbow & Co., and expects in a few days to have all men thrown out of employment at work again.—*Railway Register.*

A company has been formed, known as the Sea Cliff Elevated Railroad Company, Long Island, who are to build and operate an elevated railroad from the Sea Cliff station to the "Cliff," a distance of two and a-half miles. They also intend that the engine used in operating the railroad, which will be a cable road, shall run the dynamo to furnish the village with electric lights.—*Electrical World.*

S. A. Smith, 39 S. Canal st., Chicago, has taken the Western agency for the straight-fluted reamer drill, manufactured by the Pawtuxet Machine Co., Pawtuxet, R. I. also for Hoffman's prepared red lead. This is a preparation for plumbers, gas and steam-fitters' use. It is so prepared that it does not settle or lose its consistency, hence is always ready for instant use. It is sold in cans of convenient size.

The Arnold Print Works Co., at North Adams, Mass., quietly notified its superintendents, Saturday, of its intention to increase the wages of its cotton-mill employes, beginning March 20, ten per cent., which was the amount of the reduction a year ago. This increase at their Williamstown, North Pownal, Eclipse and Beaver Mills, affects about 12,000 people, and will add about $1,400 a month to the pay roll.

The Peerless Mfg. Co., of Louisville, Ky., in consequence of the increasing demand for their Rice sand moulding machine, illustrated in the AMERICAN MACHINIST, August 29, 1885, have purchased the property formerly occupied by the Louisville Agricultural Works. It is located on Seventeenth and Magazine streets, is 200x300 feet, with three-story building, foundry and machinery, all in working order. They will make the necessary changes and move at once.

The Pacific Mills, Lawrence, announce that the wages of the operatives will be increased the first of March in all departments. The Everett mills have the matter of raising wages under consideration, and it is believed will take favorable action, while the Pemberton will soon make a move in that direction. The Atlantic Mills managers wil also probably follow the lead of the Pacific. The Arlington already pays higher wages than the other corporations.—*Boston Journal of Commerce.*

The Tonawanda Pipe Works, at Tonawanda, N. Y., are to be refitted with the best machinery for the manufacture of pipe. Address Miles Ayrault, Bay City, Mich. Job King, Geo. W. Rockwell, and T. J. Magner, Buffalo, are fitting up the old wagon factory at 1422-1428 Niagara street. One furnace has been constructed, and when the extensions are completed two or three will be put up. A furniture manufactory is to be built in Croghan, this spring. J. V. Valin, Croghan, can give details.

According to the *Age of Steel*, the unlicensed barb wire factories of St. Louis still continue busy. The American is making twenty-two hours out of twenty-four with twenty machines, and is building new machinery to still further increase its production. The Benton and the Crescent are also actively employed. The Missouri Malleable Iron Co., St. Louis, have definitely decided upon an enlargement of their foundry, and the plans and specifications therefor are now in the architect's hands. They are at present employing fifty moulders, but have work for as many more, and will erect buildings to accommodate this additional number.

E. H. Coats & Co., of Philadelphia, have determined to erect a 10,000-spindle yarn mill on the bank of the Augusta Canal, and have closed the contract with the city for water-power. The work will be commenced on the ground in a few weeks, and the machinery will be brought out as soon as the building is finished. The mill will employ 150 hands, and will be in operation in six months. Coats & Co. were attracted to Augusta by the fine and cheap water-power and cheap skilled labor. This will make the fifth yarn mill in that city. All of those now there have been doing well, even during the depression in cotton goods spinning.—*Commercial Bulletin.*

The Albany (N. Y.) Steam Trap Co. has issued a neat little memorandum-book, convenient for engineers and lastingly bound. The first pages contain steam table, in which the notation is for pressures as shown by gauge, instead of absolute pressures, as is generally the case; this makes it more convenient for quick use by engineers. The table gives the temperature of steam and the volume of one pound up to nearly 1,000 pounds pressure. Following this is a calendar, and the back leaf contains a cut of the Blessing trap and renewable seat valve. Between these are the memorandum leaves in the form of a gilt-edge renewable pad. It is of very convenient size for the pocket.

Simmons & Peterson, of Chautauqua, N. Y., will rebuild their planing-mill, which was recently destroyed by fire. The proprietors of the Eureka Woolen Mills, Eaton, N. Y., have decided to rebuild at West Eaton. Cost, $40,000. Work will begin at once. Address, for details, Leverett L. Hamilton. H. A. Newcomb, of Augusta, Me., will furnish information in regard to the fitting up of a large building with machinery for the manufacture of wire in that city. Keene Bros., of Wellington, Me., will erect a mill next summer for the manufacture of long lumber. Mosher & Stevens, of Unity, Me., will at once erect a large steam mill for the manufacture of long and short lumber.—*New Enterprises.*

The Kilmer Mfg. Co., of Schenectady, N. Y., intend to enlarge their wire works in the spring, says *New Enterprises*, and H. M. Elbridge will start a new chair factory at Elbridge, N. Y., at about the same time. The Southern Woolen Mfg. Co., of Louisville, Ky., has been incorporated. Capital stock, $50,000. Will erect large mill building in the spring. Fichter & Martin, of Allentown, Pa., will soon add twenty new looms to their mill in South Bethlehem. The Bangor Edge Tool Co., of Bangor, Me., will purchase an eighty horse-power engine and accompanying steam works, to put in their shops next spring, and Chas. Kipp, A. F. Tanner, 250 Eighteenth street, Milwaukee, Wis., C. Stoyer, and Joseph Bubb will erect a large furniture factory to have the latest impoved machinery. Capital, $50,000. We understand that the Kilmer Manufacturing Company, above referred to, are looking over the ground at Cobbleskill, Conn., with a view to removing their works from Schenectady. If such an arrangement be made, the village will give the company land enough south and east of the depot on which to erect their numerous buildings. 175 men are now employed, but the works will be enlarged so as to give employment to 300.

Machinists' Supplies and Iron.

NEW YORK, Feb. 18, 1886.

The market has continued quiet during the past week.

Iron—In American pig the demand has continued moderate, and for small lots we quote Standard Lehigh and North River brands $18 to $18.50 for No. 1 X Foundry at tidewater; $17 to $17.50 for No. 2, and $16 to $17 for Grey Forge.

Scotch Pig—The market has ruled in the buyer's favor, and is still quiet. Moderate sales. The quoted prices have not been sustained when making sales. We quote Coltness at $20.50 to $21; Glengarnock, $20.50 to $21 to arrive; Gartsherrie, $20 to $20.50; Summerlee, $21; Eglinton, $18.25; Langloan, $20, and Dalmellington, $19.50 to $19.75.

Copper—Lake, 11.40 to 11.45c.

Tin—Jobbing lots Banca, 22½c.; Straits and Malacca, 20.75c., cash.

Spelter—Refined, 5¾c. to 6c.

Antimony—Hallett's, 8¾c.; Cookson's 9.40c.

WANTED

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Wanted—A brass moulder who thoroughly understands mixing metals; must be sober and quick worker, and come well recommended; location Western Pennsylvania: work, railroad castings. Address X, AM. MACHINIST.

Wanted—An assistant foreman in machine department of a locomotive works, west of N. Y. Must thoroughly understand above class of work. State wages expected. Address Locomotive, AM. MACHINIST.

Mechanical engineer and draftsman, experienced in shop and office, with experience as designer of machine tools, lifting machinery, turbines, engines, etc., desires situation. Address T. S., AM. MACHINIST.

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Wanted—Position as supt. of machine shop and foundry; experienced in grist-mill, saw-mill, agricultural machinery, estimating on same, and doing work by improved methods; fair draftsman and practical foundryman. A1 reference address John B. McLaren, Lansing, Mich.

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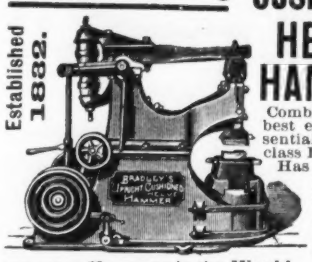

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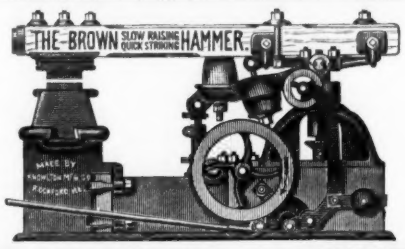

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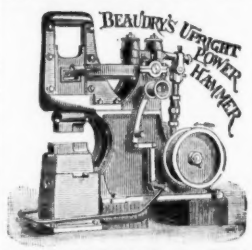

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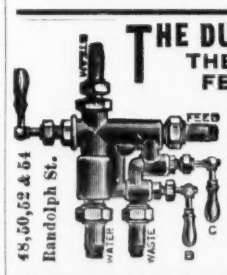

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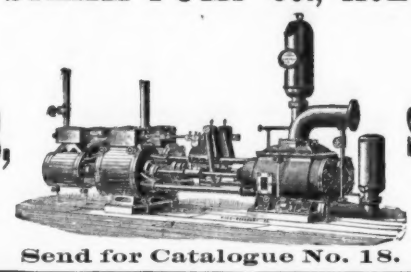

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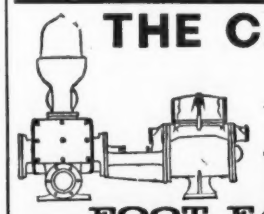

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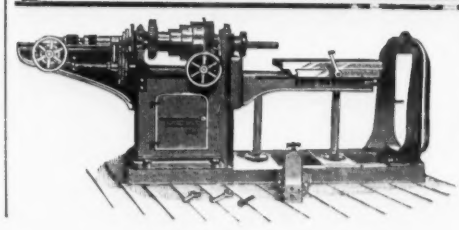

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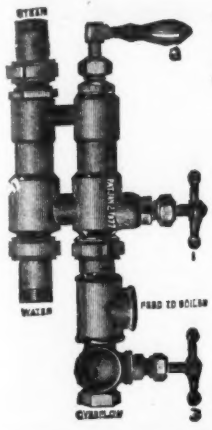

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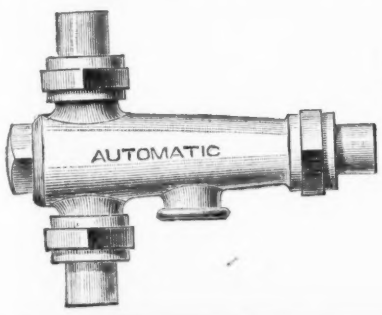

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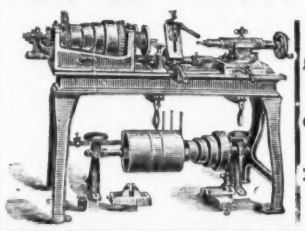

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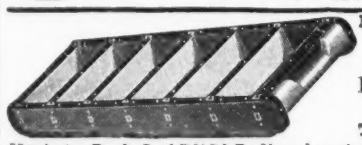

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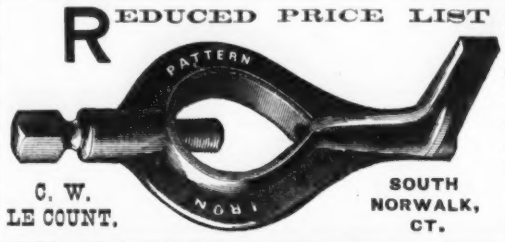

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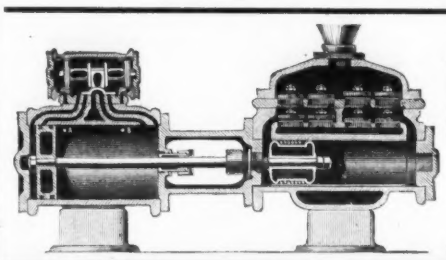

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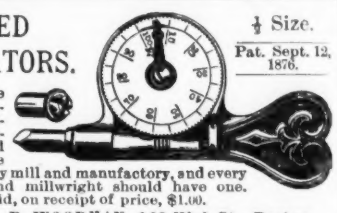

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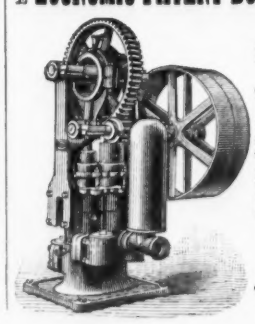

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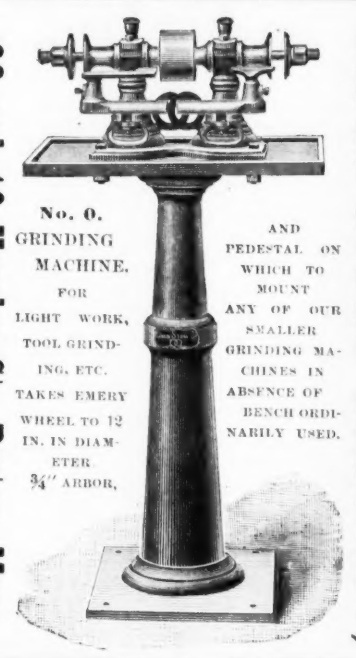

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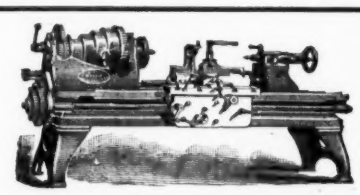

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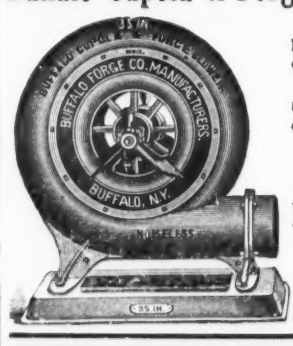

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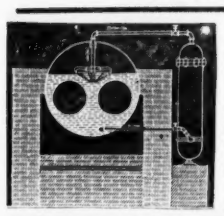

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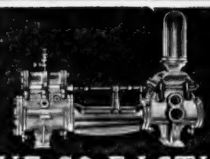

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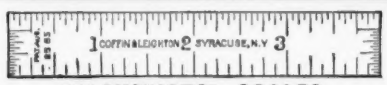

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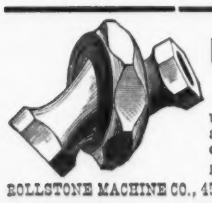

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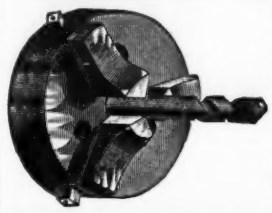

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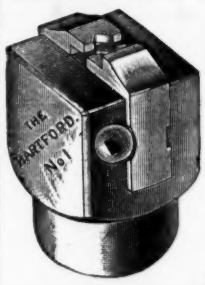

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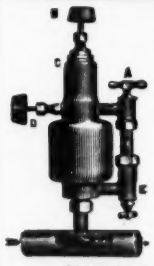

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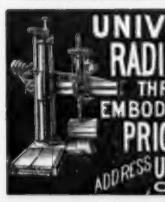

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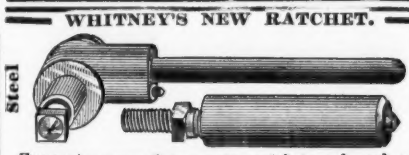

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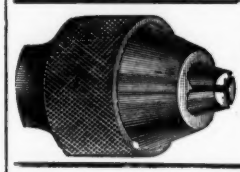

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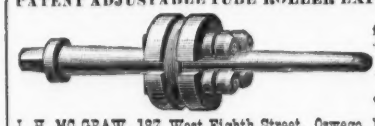

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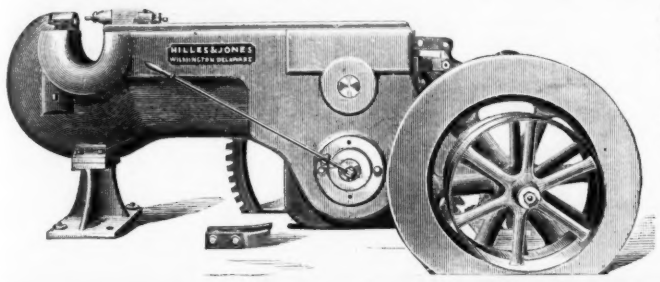

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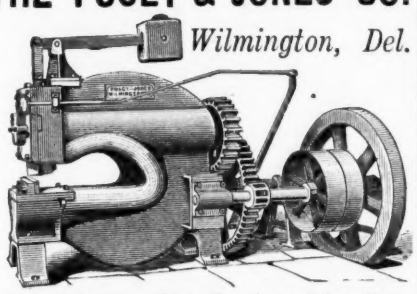

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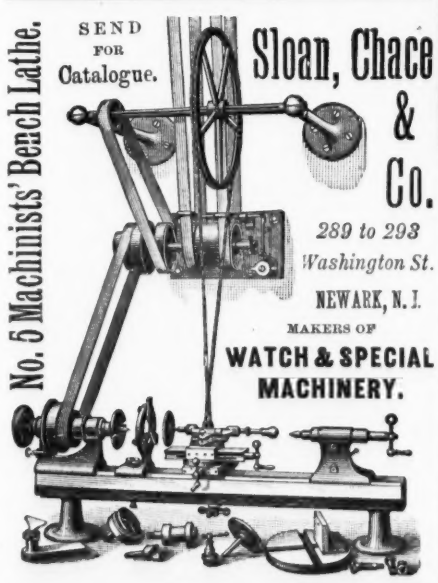

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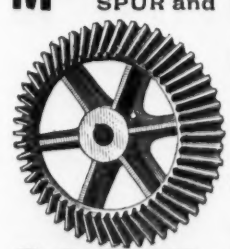

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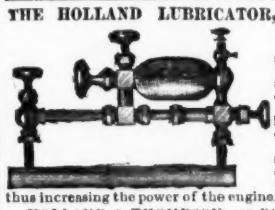

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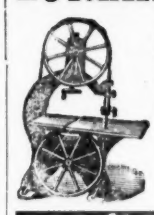

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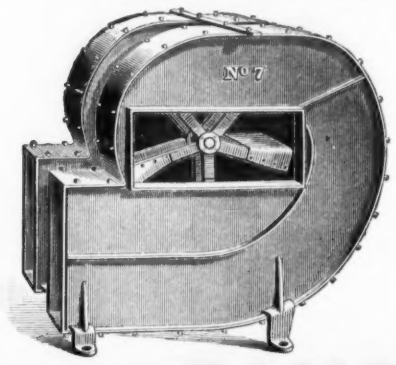

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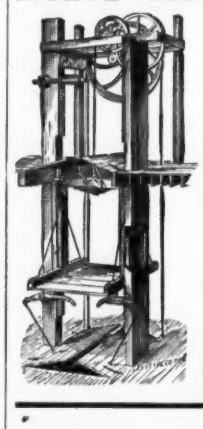

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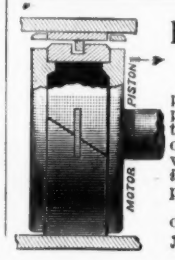

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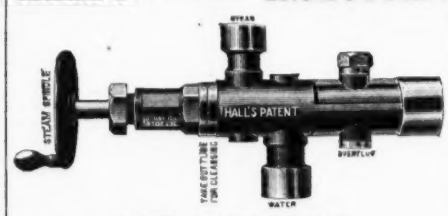

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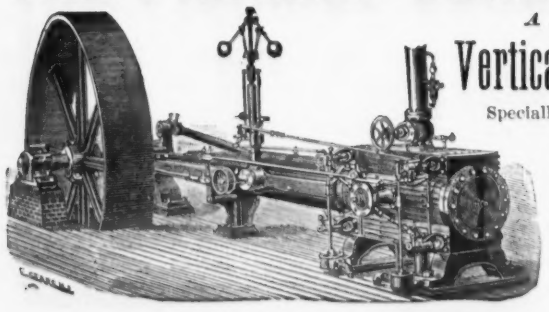

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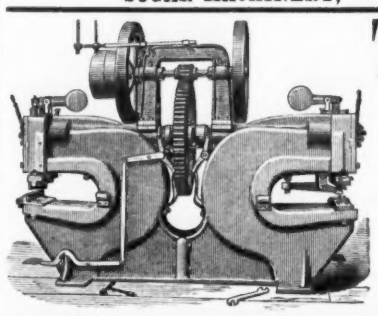

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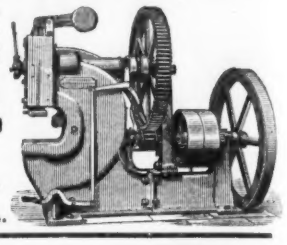

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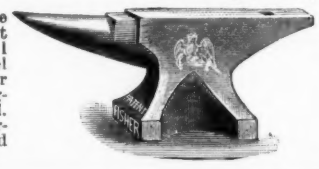

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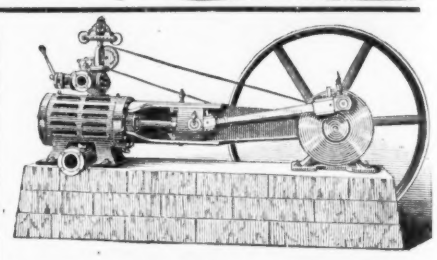

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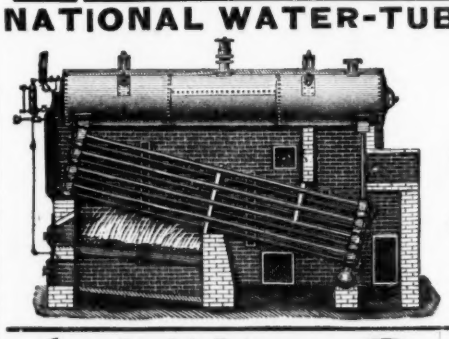

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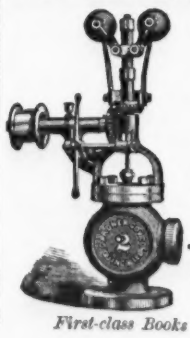

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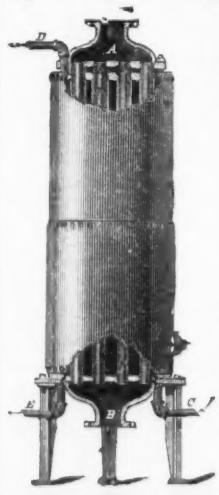

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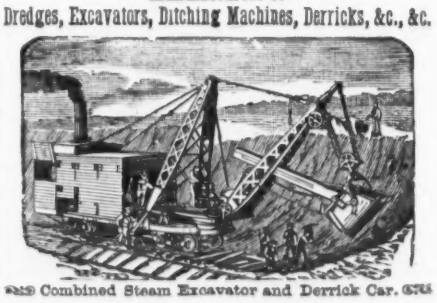

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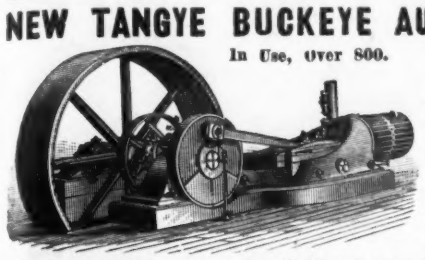

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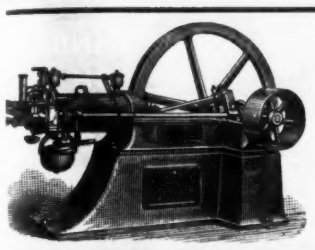

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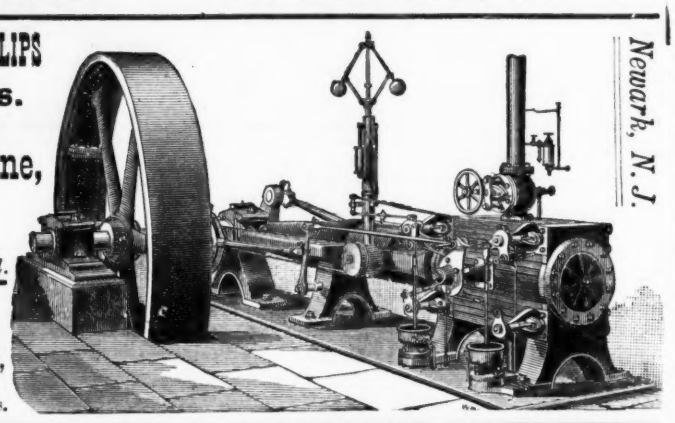

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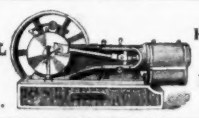

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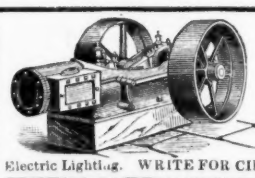

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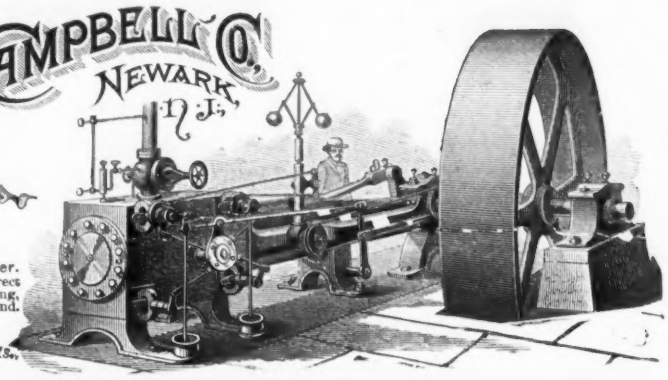

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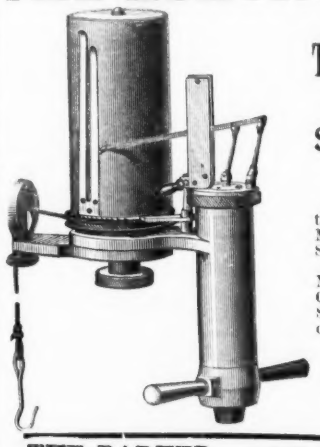

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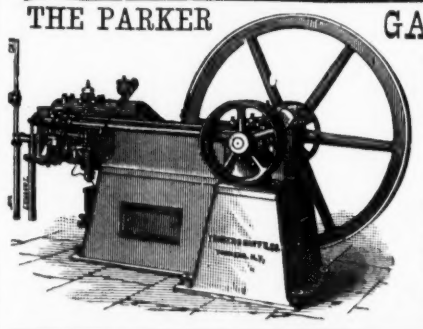

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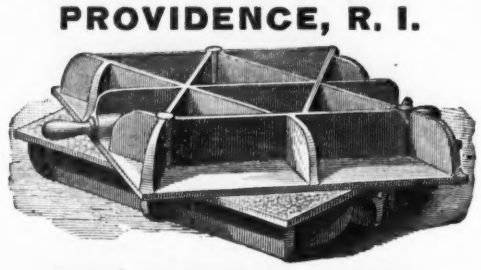

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Illustrated Catalogue Mailed on Application

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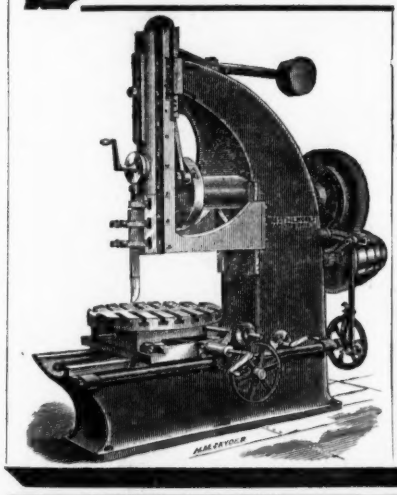

9 to 48 in. Stroke. New Patterns.

RAM GUIDE

ADJUSTABLE VERTICALLY.

Feeds always take place at upper end of stroke—never during cut.

VERY HEAVY AND POWERFUL.

NILES TOOL WORKS,

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By Power,

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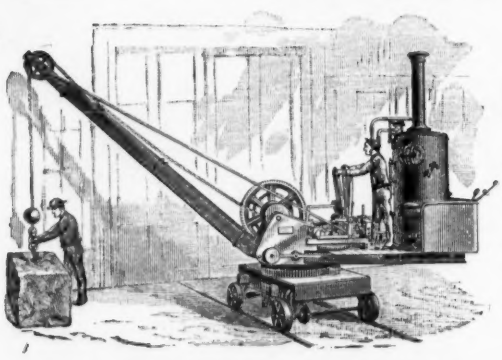

THESE CRANES are very useful for handling goods in a yard or on a wharf, and in bringing goods from the yard into a shop, or loading cars, as well as for other work.

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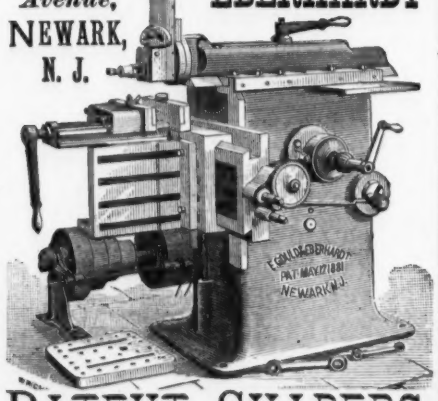

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Quick Adjustable Stroke.
Can be changed while in motion.

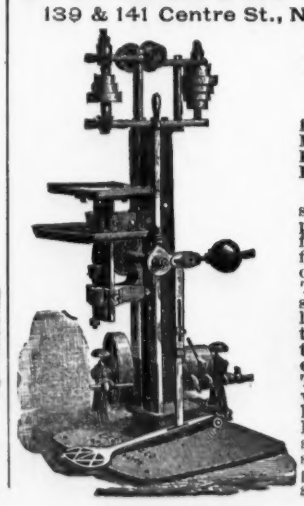
E. E. GARVIN & CO.,

139 & 141 Centre St., New York,

Manufacturers of

Machinists' Tools,

Including Milling Machines, Drill Presses, Hand Lathes, &c.



The machine shown in cut, is especially designed for jobbing, and is fitted up with one or two spindles. Those with two spindles have pulley, with two sections, which gives two speeds to each spindle. Those fitted up with one spindle have a cone pulley with three sizes. The back shaft has a cone pulley with four sizes.

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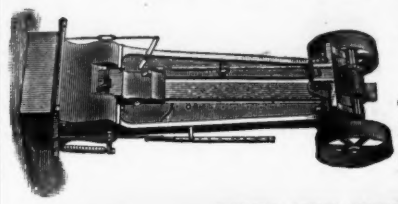

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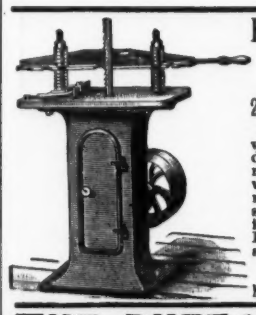

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Our Key-Seating Machine will save enough in 60 days' use to pay first cost; no shop can afford to do without one. We have now ready for prompt shipment, both Key-Seating Machines and 20-inch Drills. Send for Photo. and Catalogue.

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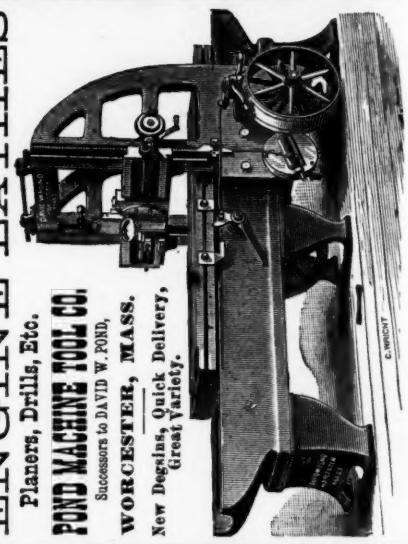

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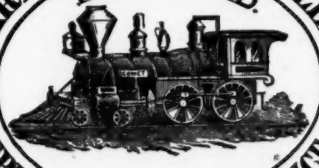

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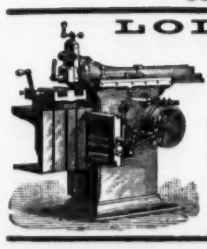

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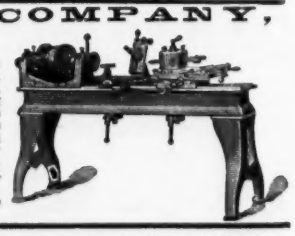

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